Combative Behaviors:: Translocating Military Medicine Research into Civilian Lifesaving

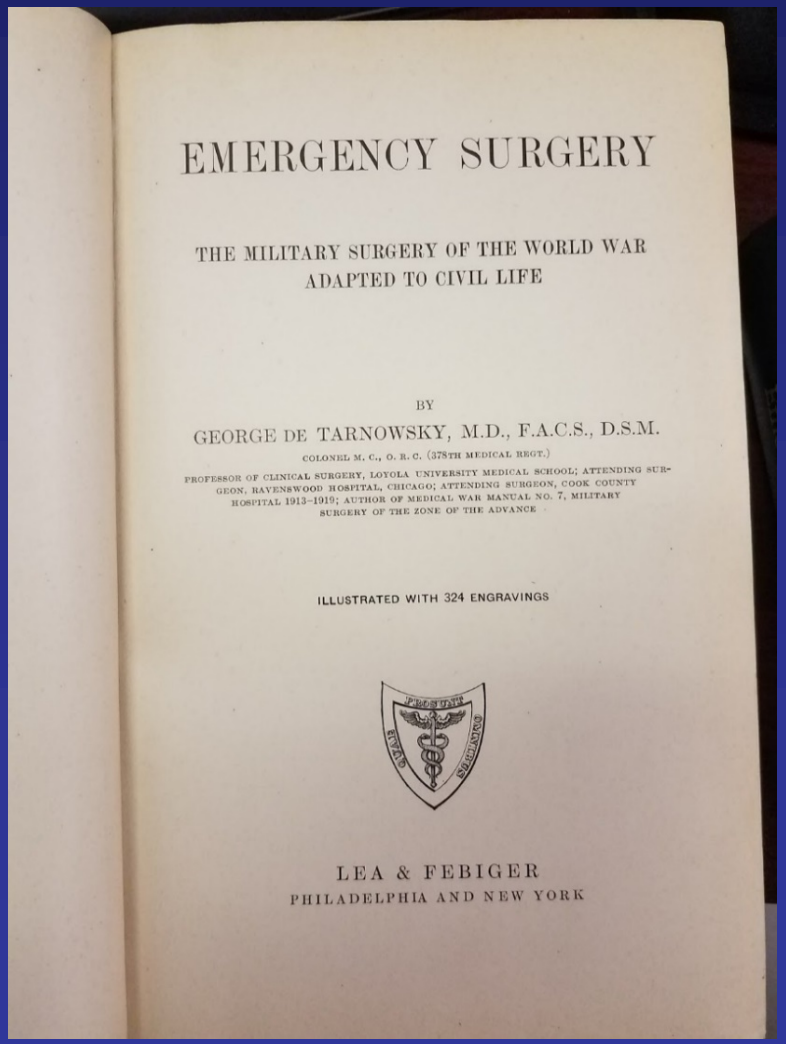
John B. Holcomb, MD, FACS
Professor of Surgery
UT Health, Houston, TX

Disclosures

• Prytime Medical	Chief Medical Officer
• Decisio Health	Founder and BoD
• Terumo BCT	Consultant
• Arsenal Medical	MAB
• Co-Inventor of the JETT	Royalty from UT

Mil to Civ Translation

WW I



EMERGENCY SURGERY

THE MILITARY SURGERY OF THE WORLD WAR
ADAPTED TO CIVIL LIFE

BY

GEORGE DE TARNOWSKY, M.D., F.A.C.S., D.S.M.

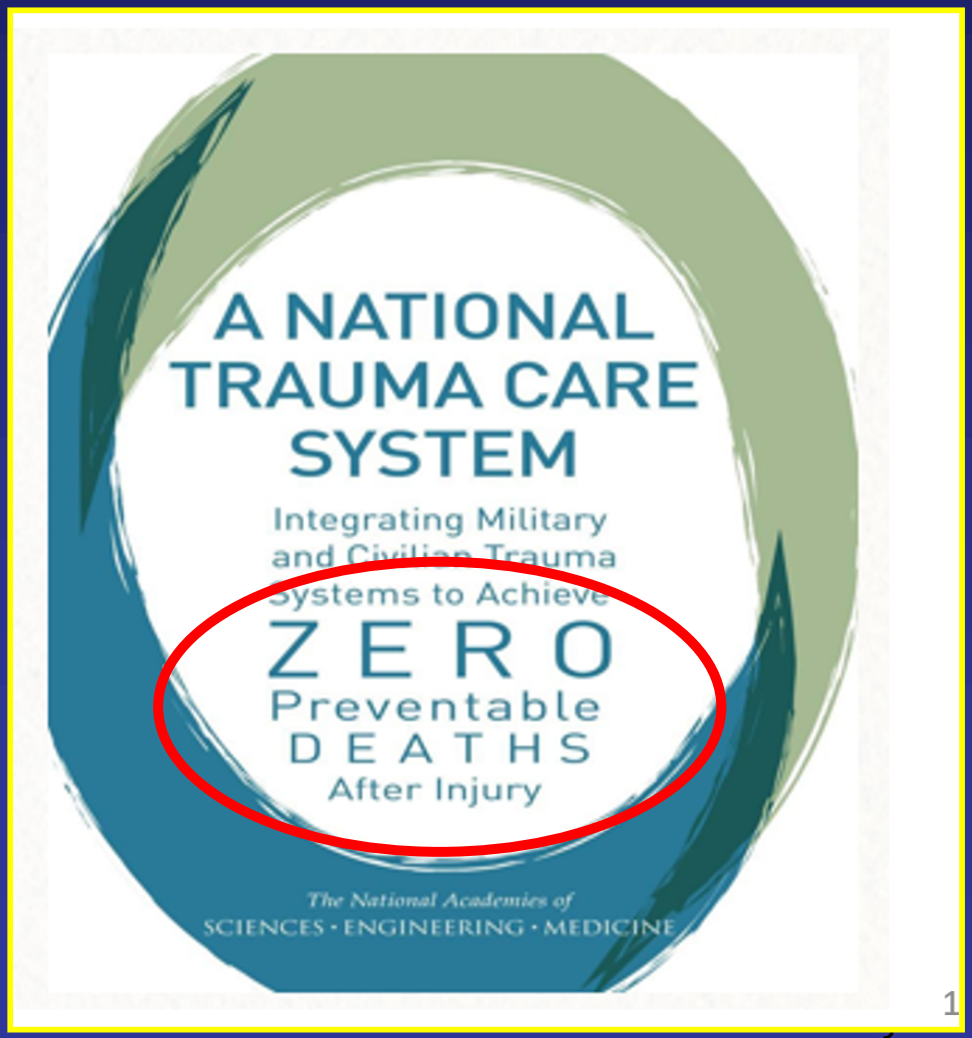
COLONEL M. C., O. R. C. (378TH MEDICAL REGT.)

PROFESSOR OF CLINICAL SURGERY, LOYOLA UNIVERSITY MEDICAL SCHOOL; ATTENDING SURGEON, RAVENSWOOD HOSPITAL, CHICAGO; ATTENDING SURGEON, COOK COUNTY HOSPITAL 1913–1919; AUTHOR OF MEDICAL WAR MANUAL NO. 7, MILITARY SURGERY OF THE ZONE OF THE ADVANCE

ILLUSTRATED WITH 324 ENGRAVINGS

LEA & FEBIGER
PHILADELPHIA AND NEW YORK

2016



Question

What is the only silver lining of war?

Civilian  Military

Improvised tourniquets, Somalia 1993

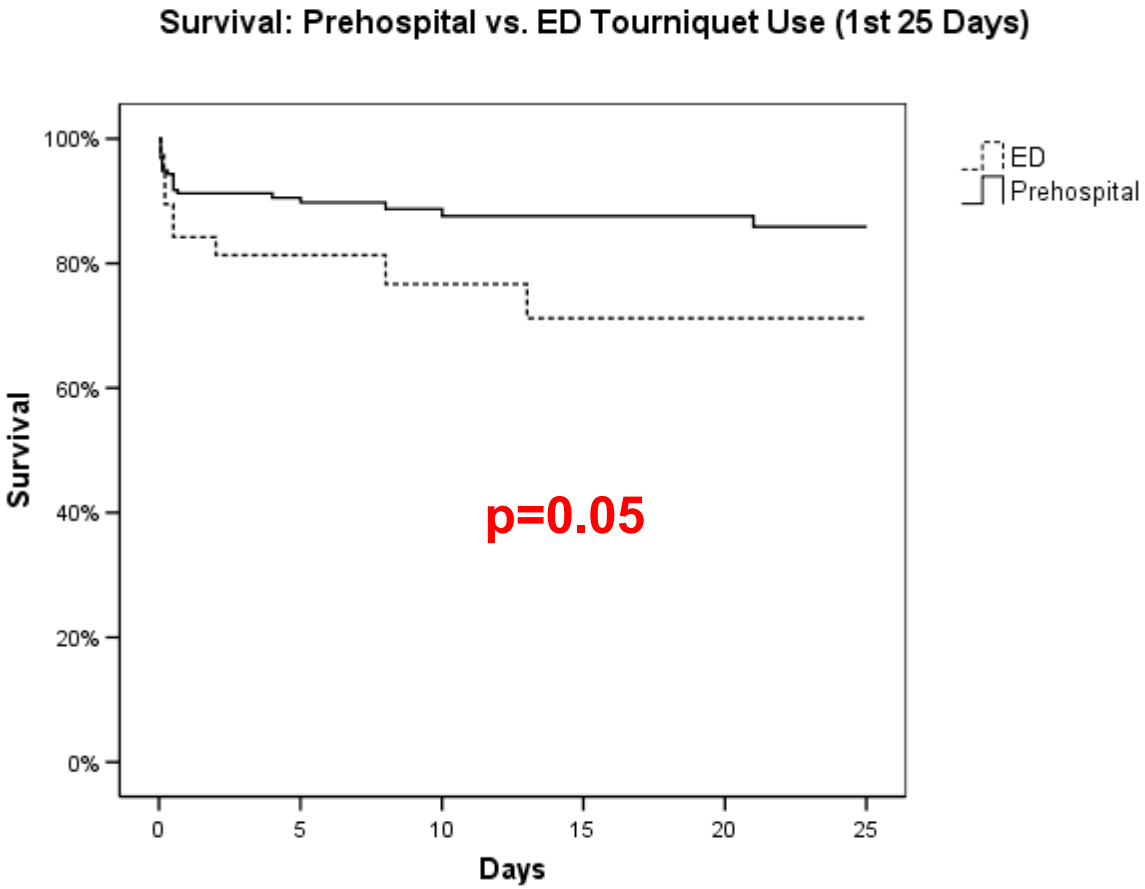
The Journal of TRAUMA® Injury, Infection, and Critical Care

J Trauma, Feb 08

Practical Use of Emergency Tourniquets to Stop Bleeding in Major Limb Trauma

John F. Kragh, Jr., MD, Thomas J. Walters, PhD, David G. Baer, PhD, Charles J. Fox, MD, Charles E. Wade, PhD, Jose Salinas, PhD, and COL John B. Holcomb, MC

- 232 patients
  - 220 males
  - ages: 4–70
    - median 28
- 309 limbs
- 428 tourniquets

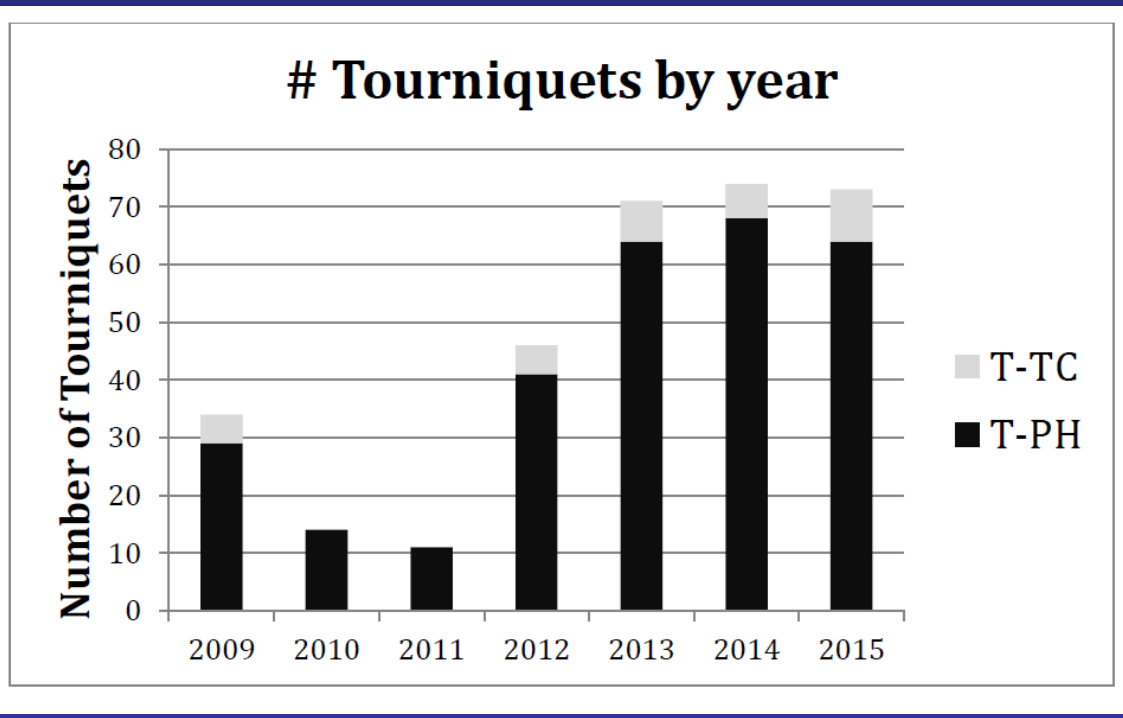


2008 --Transition of “new military ” devices to Civilian use Tourniquet and Combat Gauze

THE TRAUMA CENTER IS TOO LATE: MAJOR LIMB TRAUMA WITHOUT A PRE-HOSPITAL TOURNIQUET HAS INCREASED DEATH FROM HEMORRHAGIC SHOCK

J Trauma, 2017

Michelle H. Scerbo MD, MS[1,2], John B. Holcomb MD[1,2], Ethan Taub DO[2], Keith Gates MD[3], Joseph D. Love DO[2,4], Charles E. Wade PhD[1,2], and Bryan A. Cotton MD, MPH[1,2]



PH = 252
- 3% died of hemorrhage

TC = 29
- 14% died of hemorrhage

Training

- Military
  - TCCC
  - Start with physicians / nurses / medics
  - Now non medical folks
- Civilian
  - Stop the bleed
  - Resiliency of the population

White House, Military and Civilian Leadership working together on the Stop the Bleed Program

Dr Rick Hunt
HHS

Where are **your** Bleeding Control Kits?

Transfusion

Military

- blood

Civilian

- crystalloid

By the end of WWII
Lyophilized Plasma Resuscitation + WB
> 800,000 transfusions

FIGURE 159.—Administration of plasma on beach, only few feet from surf, to survivor of landing craft sunk off coast in first days of invasion of Normandy, June 1944.

The Journal of TRAUMA® Injury, Infection, and Critical Care

Fluid Resuscitation in Modern Combat Casualty Care: Lessons Learned from Somalia

COL John B. Holcomb, MD, FACS

J Trauma, 2003

- Fresh Whole Blood
- Hypotensive resuscitation
- Limited volume
- Use pulse character instead of blood pressure
  - Normal, weak, absent

Damage Control Resuscitation: Directly Addressing the Early Coagulopathy of Trauma

John B. Holcomb, MD, FACS, Don Jenkins, MD, FACS, Peter Rhee, MD, FACS, Jay Johannigman, MD, FS, FACS, Peter Mahoney, FRCA, RAMC, Sumeru Mehta, MD, E. Darrin Cox, MD, FACS, Michael J. Gehrke, MD, Greg J. Beilman, MD, FACS, Martin Schreiber, MD, FACS, Stephen F. Flaherty, MD, FACS, Kurt W. Grathwohl, MD, Phillip C. Spinella, MD, Jeremy G. Perkins, MD, Alec C. Beekley, MD, FACS, Neil R. McMullin, MD, Myung S. Park, MD, FACS, Ernest A. Gonzalez, MD, FACS, Charles E. Wade, PhD, Michael A. Dubick, PhD, C. William Schwab, MD, FACS, Fred A. Moore, MD, FACS, Howard R. Champion, FRCS, David B. Hoyt, MD, FACS, and John R. Hess, MD, MPH, FACP

J Trauma 2007

- Rapid progress in trauma care occurs during a war.
- Damage control resuscitation addresses **diagnosis and treatment of the entire lethal triad** immediately upon admission.

The Journal of TRAUMA® Injury, Infection, and Critical Care

Warm Fresh Whole Blood Is Independently Associated With Improved Survival for Patients With Combat-Related Traumatic Injuries

J Trauma, 2009

Philip C. Spinella, MD, Jeremy G. Perkins, MD, Kurt W. Grathwohl, MD, Alec C. Beekley, MD, and John B. Holcomb, MD

- 8,000 units of FWB since 2001

(now > 10,000)

Table 1 Comparison of Variables Between WFWB and CT Groups

Variable	WFWB (n = 100)	CT (n = 254)	*p* Value
Age (yr)	24 (21–29)	23 (21–28)	0.16
Temperature (F)	97.6 (96.4–98.2)	98.5 (97.4–99.5)	<0.001
Heart rate (bpm)	112 (95–136)	115 (91–138)	0.88
SBP (mm Hg)	110 (80–122)	109 (80–130)	0.67
GCS eye	4 (2–4)	4 (1–4)	0.32
GCS verbal	5 (1–5)	5 (1–5)	0.53
GCS motor	6 (3–6)	6 (1–6)	0.19
Hemoglobin (g/dL)	11.6 (10–14)	11.8 (9.8–13.4)	0.44
Base deficit	6 (4–10)	6 (3–11)	0.77
INR	1.4 (1.1–1.6)	1.4 (1.2–1.8)	0.83
ISS	18 (10–26)	18 (10–26)	0.74

Data presented as Median (IQR) or as percentages
SBP, systolic blood pressure; INR, International Normalized Ratio.

Prehospital and Hospital WB
Mayo, Camden, Pitt, San Antonio, Houston…

Damage control resuscitation in patients with severe traumatic hemorrhage: A practice management guideline from the Eastern Association for the Surgery of Trauma

J Trauma 2017

Jeremy W. Cannon, MD, SM, Mansoor A. Khan, MBBS (Lond), PhD, Ali S. Raja, MD, Mitchell J. Cohen, MD, John J. Como, MD, MPH, Bryan A. Cotton, MD, Joseph J. Dubose, MD, Erin E. Fox, PhD, Kenji Inaba, MD, Carlos J. Rodriguez, DO, John B. Holcomb, MD, *and* **Juan C. Duchesne, MD**, *Philadelphia, Pennsylvania*

- DCR significantly improve outcomes in severely injured bleeding patients.
  - After a review of the best available evidence, we recommend the use of a MT/DCR protocol in hospitals that manage such patients and recommend that the protocol target a high ratio of PLAS and PLT to RBC.
  - This is best achieved by transfusing equal amounts of RBC, PLAS, and PLT during the early, empiric phase of resuscitation.

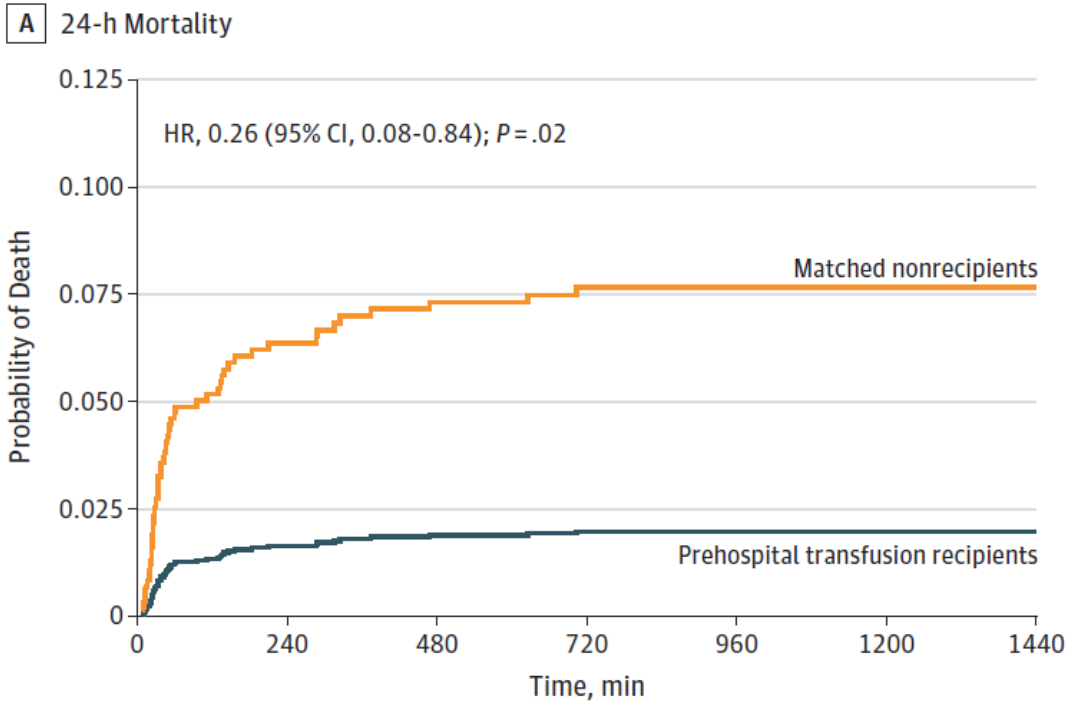
JAMA | Original Investigation

Association of Prehospital Blood Product Transfusion During Medical Evacuation of Combat Casualties in Afghanistan With Acute and 30-Day Survival

JAMA, 2017

Stacy A. Shackelford, MD; Deborah J. del Junco, PhD; Nicole Powell-Dunford, MD; Edward L. Mazuchowski, MD, PhD; Jeffrey T. Howard, PhD; Russ S. Kotwal, MD, MPH; Jennifer Gurney, MD; Frank K. Butler Jr, MD; Kirby Gross, MD; Zsolt T. Stockinger, MD

- "Prehospital blood product transfusion in trauma care remains controversial due to poor-quality evidence and cost"



N = 505

5 vs 19% 24 hr mortality

11 vs 23% 30 day mortality

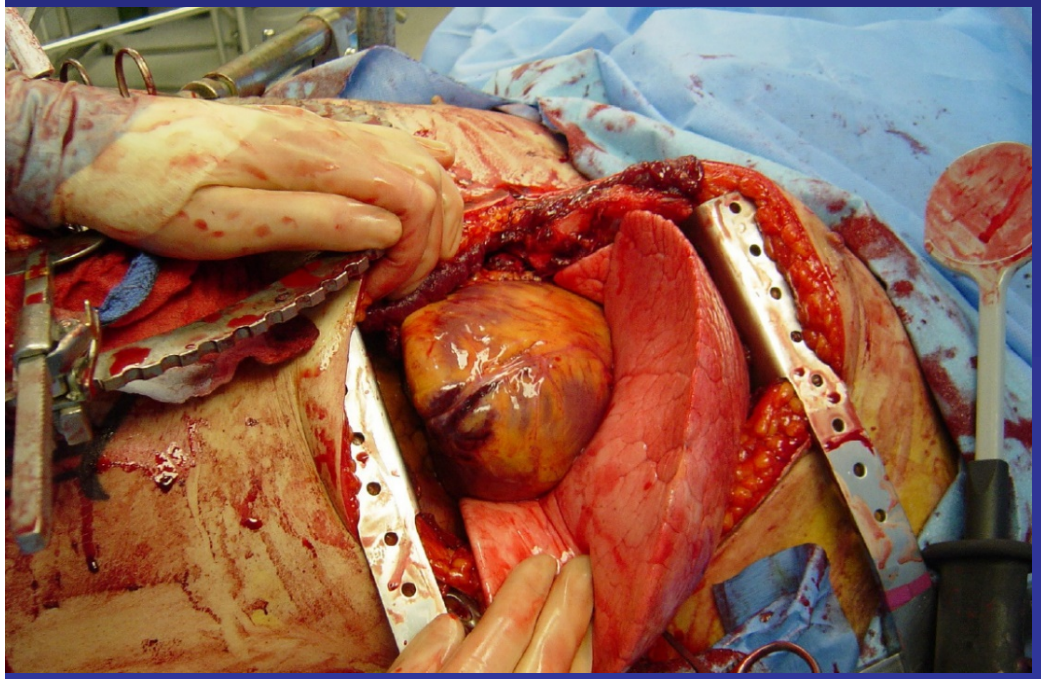
Crystalloid is going away in shock resuscitation

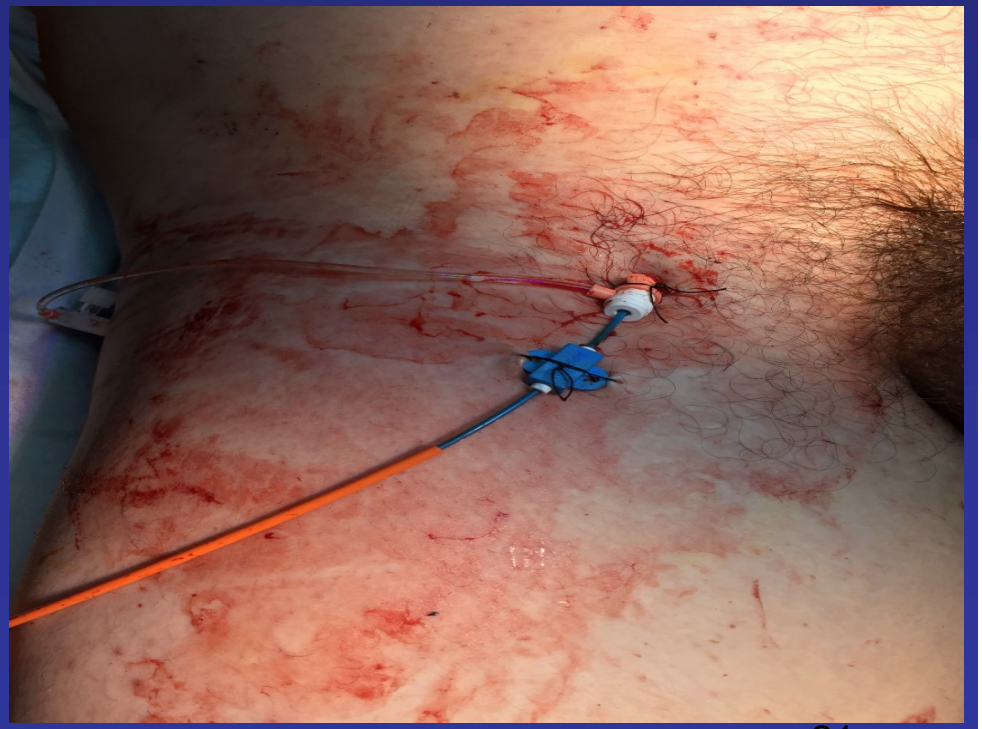
Implementation of resuscitative endovascular balloon occlusion of the aorta as an alternative to resuscitative thoracotomy for noncompressible truncal hemorrhage

J Trauma 2015

Laura J. Moore, MD, Megan Brenner, MD, Rosemary A. Kozar, MD, PhD, Jason Pasley, DO, Charles E. Wade, PhD, Mary S. Baraniuk, PhD, Thomas Scalea, MD, *and* **John B. Holcomb, MD,** *Houston, Texas*

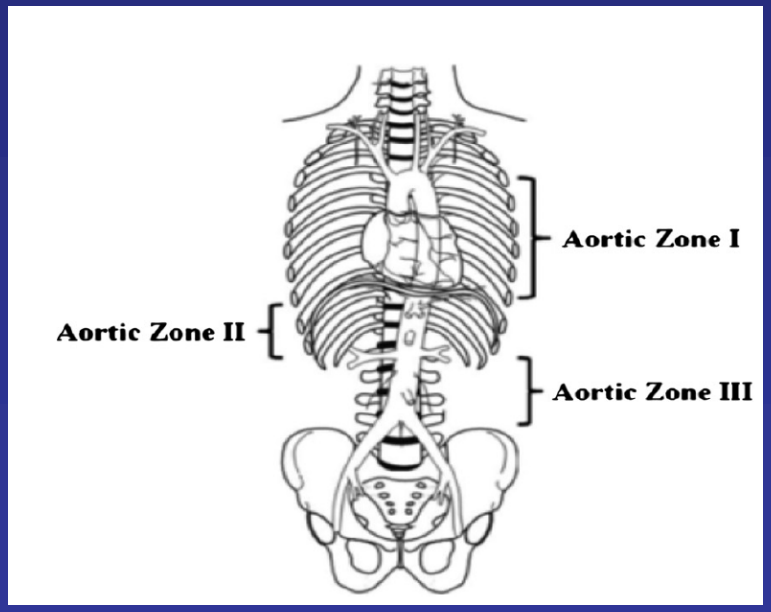
Truncal Hemorrhage Control

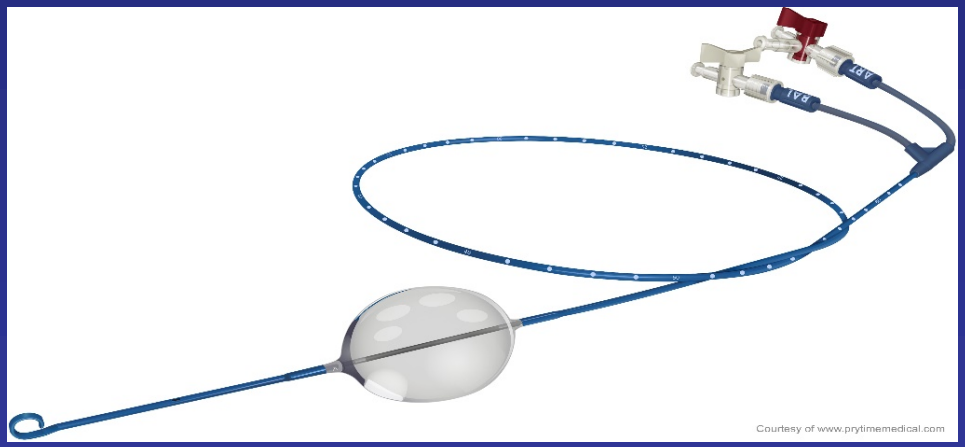




REBOA (Zone 1 and 3 very different)

FDA cleared, used in > 200 hospitals, 100 Level 1 centers, and austere deployed setting
Avoid use with significant hemorrhage above diaphragm
Zone 1 shorter occlusion time than Zone 3
3 Multicenter human studies ongoing





Fisher AD, et al. The Role I Resuscitation Team and Resuscitative Endovascular Balloon Occlusion of the Aorta. J Spec Oper Med. 2017.

ResQFoam

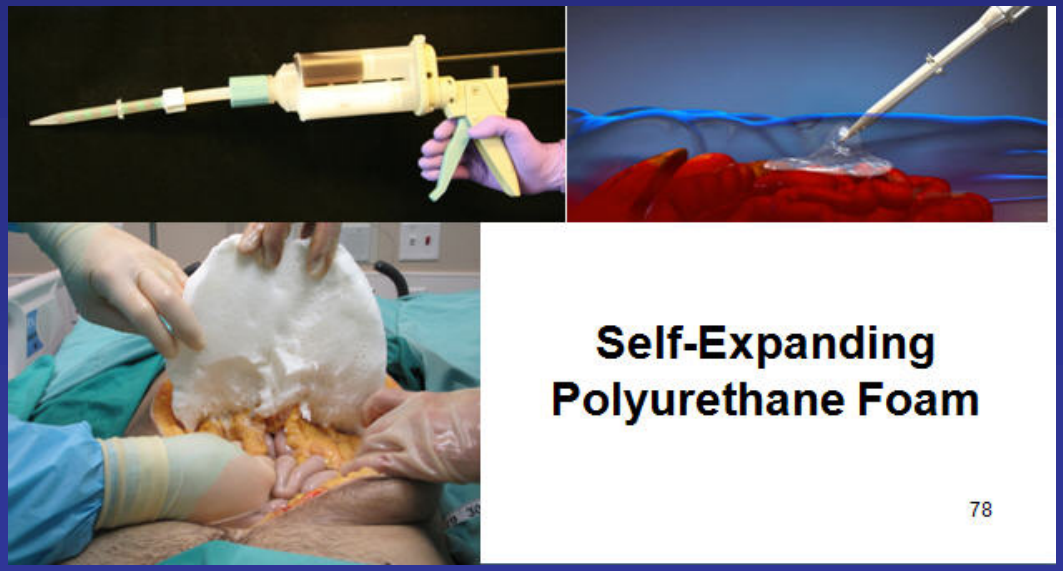
In multiple animal studies, controls liver, spleen and iliac artery injuries above and below aortic bifurcation

3 hour treatment duration safe in animals

Potentially avoid use in patients with significant diaphragm or abdominal wall holes

Avoid use with significant hemorrhage above diaphragm

Cleared to start multicenter FDA regulated human trial (2018)



Dr Harvin, Local PI

Rago AP, et al. Conceptualized Use of Self-Expanding Foam to Rescue Special Operators From Abdominal Exsanguination: Percutaneous Damage Control for the Forward Deployed. J Spec Oper Med, 2015

Research Funding

- Public Health Issue
- Military
  - Up after war starts and down in-between
- Civilian
  - Rate less than middle ear infections

Transfer of Practice

- In between wars Civilians set the standard of care
- During wars, Military leads innovative trauma care

- Drift from Military to Civilian
  - Ex military that move into civilian practice
  - Literature and meetings

- With military style injuries increasing
  - Imperative to broadly implement the hard won lessons learned

- Thank you for letting me participate

- Prehospital teams
  - Military and Civilian
    - Especially in Houston
- Paul Pepe and the Eagles
  - Background work in so many areas
  - Just getting stuff done