The Art of Trauma Resuscitation

Who is this Doc?

- Attending Emergency Physician
- Board Certified EMS Physician
- Medical Director, Tacoma Fire Dept.
- Former EMT and Flight Physician
- FEMA USAR WATF 1

Why I am here…

What we do & what we don't do actually makes a difference…

EMS is a Practice of Medicine…

"We are in the business of delivering health care to a very unique population, in a very unique environment in a very unique way…"

Financial Disclosures

I have no financial affiliation with any corporate sponsor, organization, or product discussed within any presentation

Objectives

- Define the "Lethal Triad"
- Recognize what we can do to make a difference
- Understand the role of EMS in Damage Control Resuscitation
- Look to the future…

CASE

It was a dark & stormy night…

46 yo male

- E11, E15, M5, M2, B3 @ 0200: GSW
- Failed home invasion
- 2 victims: one possible DOA per police
- Scene is secure

46 yo male

- Primary Survey
  - ✓ Lethargic & confused
  - ✓ Airway patent
  - ✓ Breathing labored
  - ✓ No radial pulse
  - ✓ Weak carotid pulse
- GSW x 2 center abdomen

46 yo male

66/P 131

31 95%

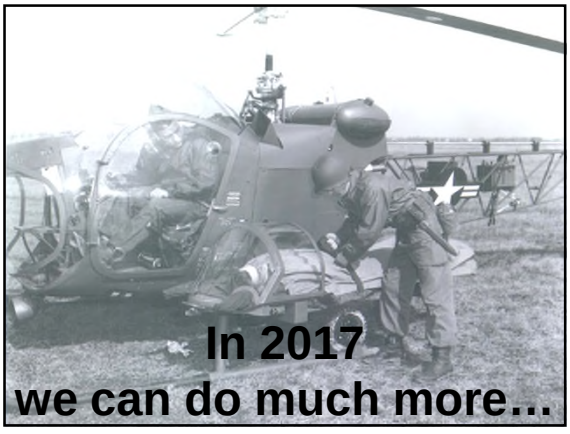
46 yo male

ETCO2: 20mmHg

Glucose: 410

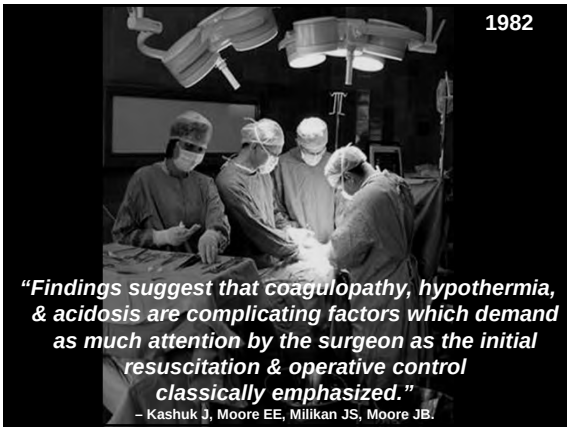

30 minutes

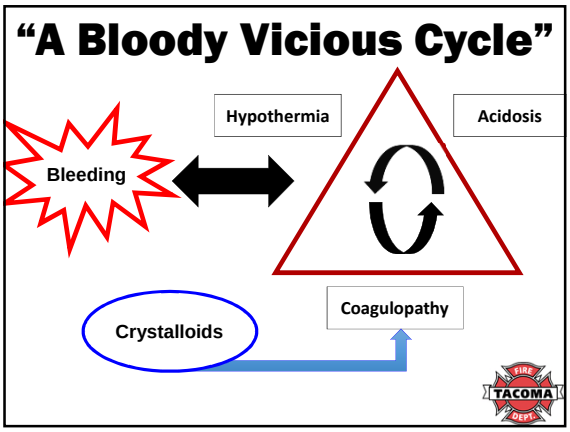

What can you do?
AMBULANCE
"The most important thing you can do is bring the patient to ME so I can save their life…"
- Anonymous Surgeon


In 2017
we can do much more…


KNOW YOUR
ENEMY
TACOMA


The Lethal Triad
TACOMA


1982
"Findings suggest that coagulopathy, hypothermia, & acidosis are complicating factors which demand as much attention by the surgeon as the initial resuscitation & operative control classically emphasized."
– Kashuk J, Moore EE, Milikan JS, Moore JB.



Tenets of the Triad

- It **STARTS** with bleeding…
- It **ENDS** with death…
- You can **NOT** predict when it will occur nor how severe it will be…
- Once started it **WILL** spiral out of control

Hypothermia

- **Normal body temp** is classically 37C / 98.6F
- **Hypothermia**: core temperature < 35C / 95F
- **Critically important** to distinguish environmental exposure hypothermia from hypothermia in trauma

Hypothermia

- In a study of over 400 cases of hypothermia due to exposure, a core temp **< 32C (89.6F) had a 21% mortality**

- In a study of 71 trauma victims, a core temp **< 32C** was associated with a **100% mortality rate**

Independent of the presence of shock, injury severity, or volume of fluid resuscitation

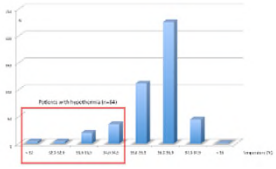
Hypothermia

- **Several studies have demonstrated a significantly higher mortality among trauma victims with hypothermia**
- **Trauma patients with hypothermia require more fluids, blood transfusion, & longer hospital stays**

Risk factors for onset of hypothermia in trauma victims: The HypoTraum study

Frédéric Lapostolle[1,2*], Jean Luc Sebbah[3], James Couvreur[4], François Xavier Koch[5], Dominique Savary[6], Karim Tazarourte[7], Gerald Egman[8], Lynda Mzabi[1,2], Michel Galinski[1,2] and Frédéric Adnet[1,2]

CRITICAL CARE
2012



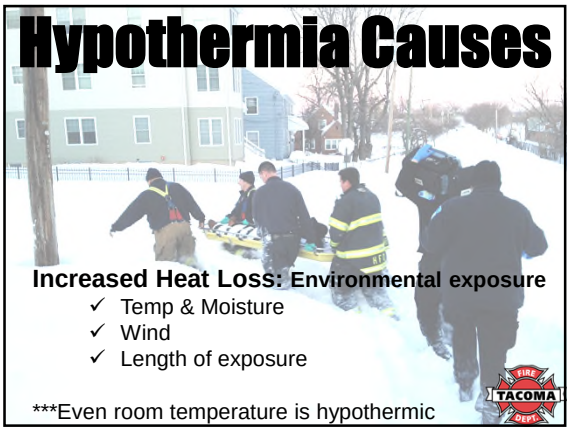
14% of patients < 35° C

Risk Factors

- ✓ Severity of injury
- ✓ Elderly
- ✓ Head injury
- ✓ Intubation
- ✓ Fluid temp (< 21C / 70F)
- ✓ Transport unit temp
- ✓ Patient completely unclothed

Scene temperatures **NOT** an independent risk factor

Hypothermia Causes



Increased Heat Loss: Environmental exposure

- ✓ Temp & Moisture
- ✓ Wind
- ✓ Length of exposure

***Even room temperature is hypothermic

Hypothermia Causes

Increased Heat Loss

- Blood Loss
- Fluids, Fluids, Fluids **(ROOM AIR IS COLD)**
- Blood products
- Burns

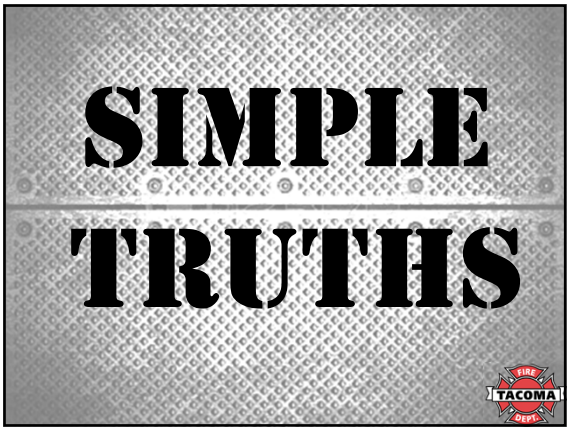
Hypothermia Causes

Decreased heat production + impaired thermoreg

- Injury and hemorrhagic shock
- Traumatic brain injury & spinal cord injuries
- Associated medical conditions
- Alcohol intoxication
- Certain medications and illicit drugs
- Patients at the extremes of age
- Sedation and paralytics

***** Trauma patients rarely shiver*****

Consequences of Hypothermia in Trauma	
Cardio vascular	**Decreased cardiac output** & myocardial ischemia
	Decreased cardiovascular response to catecholamines (epinephrine)
	Arrhythmias such as ventricular fibrillation
	Peripheral vasoconstriction & impaired release of O2 from hemoglobin
	Increased oxygen consumption from shivering
Bleeding	**Decreased function of coagulation factors to make clot** (10% for each ° decrease in temp)
	Reduced platelet function to make clot
Infection	Decreased white blood cell number and function
	Increased risk of wound infection, pneumonia, and sepsis



Hypothermia

1. Unintended hypothermia in trauma victims is a common problem
2. Multiple reasons why hypothermia occurs early in the resuscitation
3. A key factor in the lethal triad
4. It is happening before your eyes… regardless of the season

At the end of the day…

Hypothermia in trauma increases the likelihood of death

ACIDOSIS

ACIDOSIS

- pH is a measure of the blood's acidity on a scale of 0-14
- Water has a "neutral" pH of 7.0
- **Normal blood pH is 7.35-7.45**
- **Acidosis is an arterial pH < 7.35**
  1. Metabolic Acidosis
  2. Respiratory Acidosis

Causes of Acidosis

- **Poor perfusion to the tissues**
  - Impaired O2 delivery to tissues
    - ✓Acute blood loss
    - ✓Peripheral vasoconstriction
    - ✓Decreased cardiac output
  - **Tissue O2 demand > O2 delivery = SHOCK**
  - Cells are forced to utilize anaerobic metabolism resulting in the production of lactic acid **(metabolic acidosis)**

LACTATE – A MARKER FOR SEPSIS AND TRAUMA

- Lactate is a screening test for **CRYPTIC SHOCK**

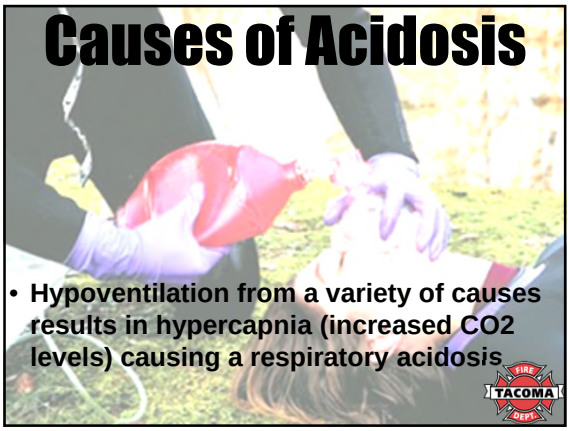
Table 1. Causes of Lactic Acidosis

Inadequate oxygen delivery	Disproportionate oxygen demands	Inadequate oxygen utilization
Volume depletion or profound dehydration	Hyperthermia	Systemic inflammatory response syndrome
Significant blood loss	Shivering	Diabetes mellitus
Septic shock	Seizures	Total parenteral nutrition
Profound anemia	Strenuous exercise	Thiamine deficiency
Severe hypoxemia		HIV infection
Prolonged carbon monoxide exposure		Drugs such as metformin, salicylate, antiretroviral agents, isoniazid, propofol, cyanide
Trauma		

** > 4 mmol/L suggests SEVERE BADNESS **

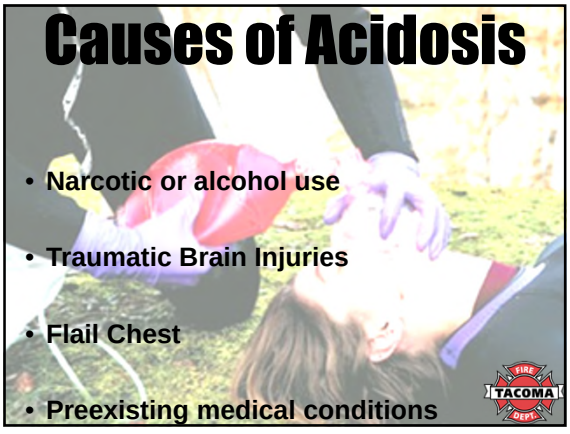
Causes of Acidosis

- Excessive resuscitation using unbalanced crystalloid solutions (NS or LR)
- Hyperchloremic metabolic acidosis worsens lactic acidosis



Causes of Acidosis

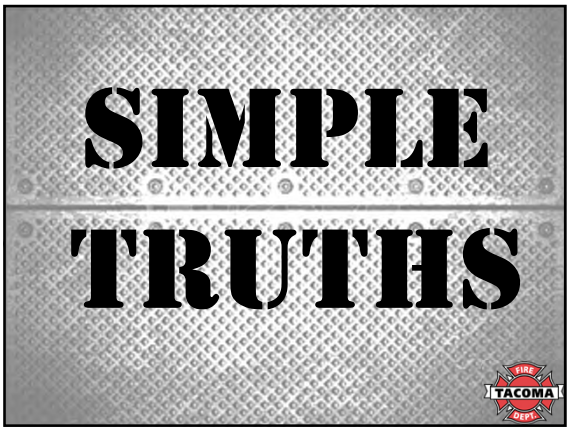
- **Hypoventilation from a variety of causes results in hypercapnia (increased CO2 levels) causing a respiratory acidosis**



Causes of Acidosis

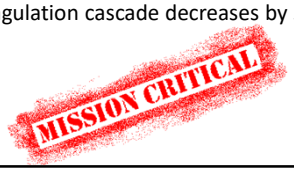
- **Narcotic or alcohol use**
- **Traumatic Brain Injuries**
- **Flail Chest**
- **Preexisting medical conditions**

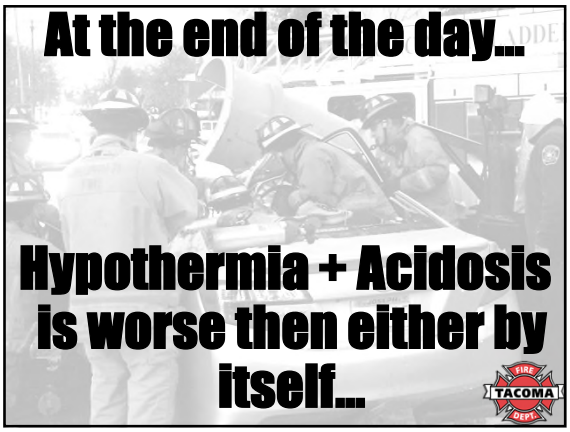
Consequences of Acidosis in Trauma	
Cardio vascular	**Decreased cardiac output** & arterial blood pressure
	Decreased cardiovascular response to catecholamines (epinephrine)
	Reduced threshold for developing **arrhythmias** such as ventricular fibrillation
Pulmonary	Hyperventilation
	Decreased strength and increased fatigue of respiratory muscles
Brain	**Decreasing mental status and coma**
Bleeding	**Decreased function of coagulation factors** to make clot
	Reduced platelet function to make clot



ACIDOSIS

1. Your patient is likely already acidotic…
2. Sometimes your treatment can make it worse!!!
3. When the pH drops from 7.4 to 7.0 activity of parts of the coagulation cascade decreases by 55-70%

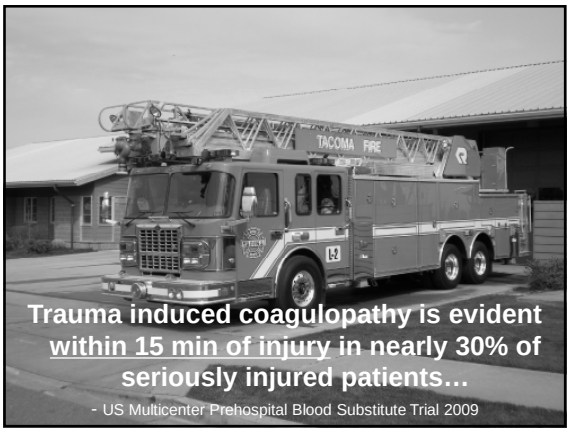




COAGULOPATHY

COAGULOPATHY

- **Condition in which the bodies ability to make clot & thus stop hemorrhage is impaired**
- Present in nearly **1 in 4 severely injured patients** arriving in the ED
- Its presence is associated with a **4-5 fold increase in mortality**



Causes of COAGULOPATHY

- **Hypothermia & Acidosis** impairs the proteins & enzymatic reactions required to form blood clots
- **Massive tissue injury** releases cytokines & hormones causing a significant systemic inflammatory response.
- **Hemorrhage** causing loss of clotting factors

Causes of COAGULOPATHY

- **Hypoxia**
- **Dilution** of the remaining clotting factors is a major problem
- **Abnormal activation of the clotting cascade** out of proportion to injury resulting in fibrinolysis (clot break down) and a further deficiency of the factors

Causes of COAGULOPATHY

- **TBI** worsens coagulopathy. (Over 80% of patients presenting with GCS < 6)
- **Preexisting medical conditions** (liver or renal failure)
- **Medications** (Coumadin or a novel anticoagulant)

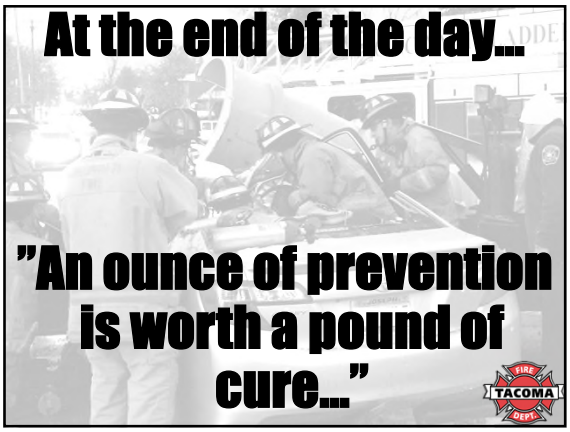
*****The coagulopathy of trauma is complex & not completely understood**

SIMPLE TRUTHS

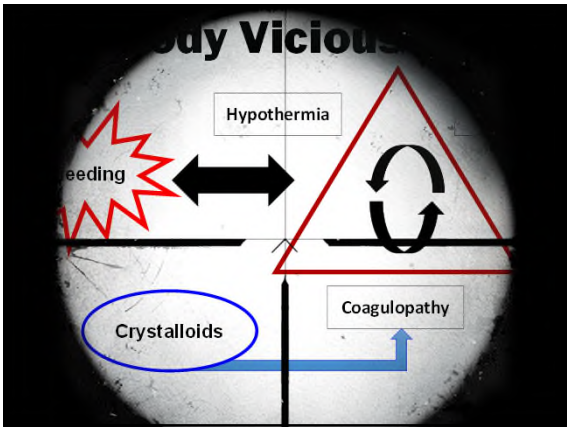
COAGULOPATHY

1. Trauma patients are frequently coagulopathic
2. The more severely injured, the worse the coagulopathy
3. Coagulopathy results in worsening hemorrhage
4. Once the coagulopathy of trauma is present, it is very difficult to reverse

MISSION CRITICAL


At the end of the day...
"An ounce of prevention is worth a pound of cure..."


EMS
MANAGEMENT


Hypothermia
Crystalloids
Coagulopathy


Do NOT underestimate the environment
Patients can & will become hypothermic in conditions you consider warm


Cold hard backboard…
Create an insulated surface


Promptly remove wet clothing
Shivering is a waste of energy & oxygen

"Strip`em & Flip `em"

- With surgical precision
- Perform a complete exam… **BUT** expose only those body parts you are actively examining

Warming Blankets

Ready-Heat Blankets

US Military Medical Protocol Since 2005

80F

Warmed Fluids

Humeral IO

- 10 seconds to access
- Easy to do enroute
- 15g every time
- "Central line"
- Above the diaphragm
- 5x the flow rate
- Less pain

Maximize oxygenation as needed & Treat causes of Hypoventilation

Control Hemorrhage

- Lethal triad begins with bleeding…
- 2nd leading cause of trauma mortality
- **Leading cause of preventable death**
- **56% of bleeding deaths occur prehospital**
- **We must STOP NOT SLOW…**

Do NOT Stop Looking

- Posterior
- Axillae & Perineum
- Under equipment
- Between the folds
- "Down the street"

Control Hemorrhage

- Most bleeding… even arterial bleeding… can be controlled with **good direct pressure**
- But certain situations require more…

Do NOT hesitate…

Early control is critical

Recent Military Conflicts

- **Increased support for EARLY tourniquets**
- **2011 study showed tourniquet use prior to hemorrhagic shock resulted in a 96% survival compared to 4% when applied after the onset of shock**
- **Few if any permanent limb ischemic injuries have been shown to have resulted from military tourniquet use**

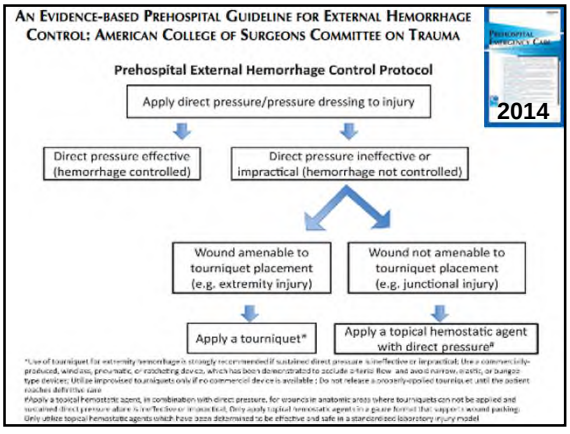
Recent Military Conflicts

- **A complete change in task prioritization…**
  - ✓ **MARCH vs. ABCs**

- ❖ **Massive hemorrhage**
- ❖ **Airway**
- ❖ **Respirations**
- ❖ **Circulation**
- ❖ **Hypothermia/Head injury**

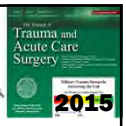
Control Hemorrhage

- Civilian death due to isolated extremity hemorrhage is rare (0.02% of traumas) but… > 50% are preventable with tourniquets.
- Multi-system trauma
- MCI's
- Special Operations: tactical, confined space



Traumatic intra-abdominal hemorrhage control: Has current technology tipped the balance toward a role for prehospital intervention?

Muzzafer Chaudery, MRCS, James Clark, MRCS, Mark H. Wilson, FRCS, Duncan Bew, FRCS, Guang-Zhong Yang, PhD, *and* Ara Darzi, FRS, *London, United Kingdom*



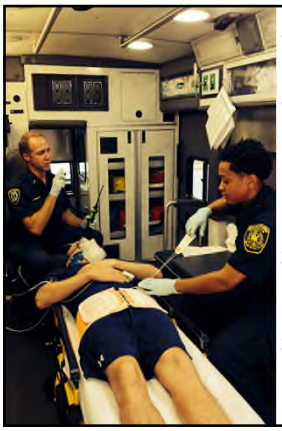
- Examine the current technologies available for prehospital abdominal hemorrhage control
  1. **Mechanical compression**
  2. **Endovascular control**
  3. **Energy based hemostatic devices**
- In the majority of cases, morbidity & blood loss was decreased.

TACOMA

http://www.arsenalmedical.com/foam-system-acute-hemorrhage

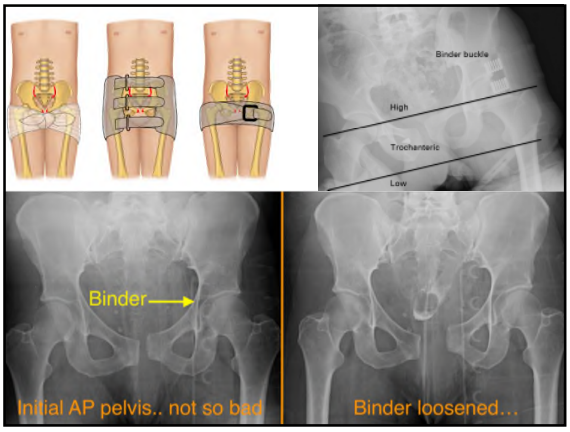
Dec 2014

- We often forget what we cannot see…
- When do you bind a pelvis?
- How do you bind a pelvis?



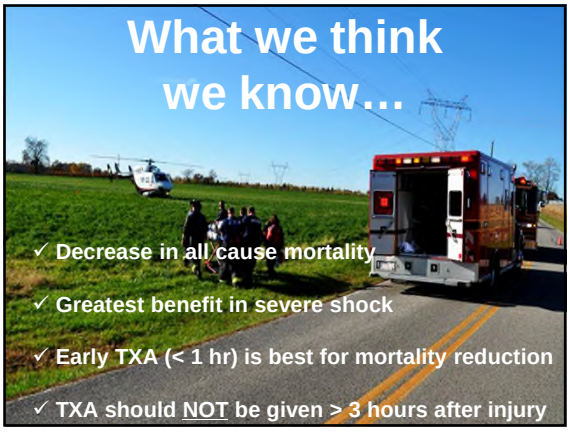
- **Suspicion** is key…
- ***"Rocking"*** the pelvis is ridiculous

1. **Obvious pelvis instability**
2. **Blunt trauma + Shock + low back pain, tenderness**
3. **Blunt trauma + Shock + GCS < 13**



Who Gets TXA?

- Age ≥ 16
- Significant trauma
- Hemodynamically unstable
- Time of injury MUST be < 3 hours
- 1g TXA in 100ml NS or LR over 10 min



EMS RESUSCITATION

We do NOT bleed normal saline...

REMEMBER

- Acidotic
- Hypothermic
- Dilutional

MISSION CRITICAL

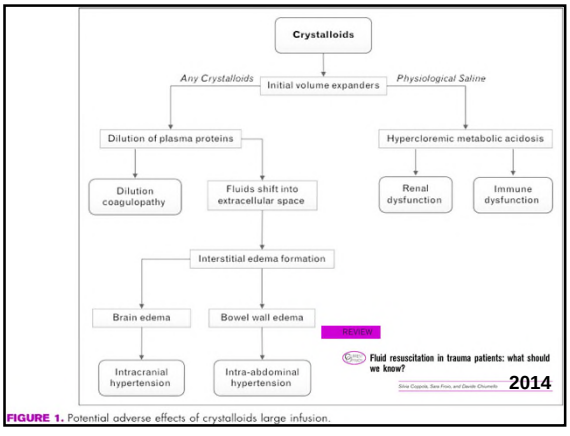


FIGURE 1. Potential adverse effects of crystalloids large infusion.

The New England
Journal of Medicine

Volume 331 OCTOBER 27, 1994 Number 17

IMMEDIATE VERSUS DELAYED FLUID RESUSCITATION FOR HYPOTENSIVE PATIENTS WITH PENETRATING TORSO INJURIES

William H. Bickell, M.D., Matthew J. Wall, Jr., M.D., Paul E. Pepe, M.D., R. Russell Martin, M.D., Victoria F. Ginger, M.S.N., Mary K. Allen, B.A., and Kenneth L. Mattox, M.D.

Abstract *Background.* Fluid resuscitation may be detrimental when given before bleeding is controlled in patients with trauma. The purpose of this study was to determine the effects of delaying fluid resuscitation until the time of operative intervention in hypotensive patients with penetrating injuries to the torso.

Methods. We conducted a prospective trial comparing immediate and delayed fluid resuscitation in 598 adults with penetrating torso injuries who presented with a prehospital systolic blood pressure ≤90 mm Hg. The study setting was a city with a single centralized system of prehospital emergency care and a single receiving facility for patients with major trauma. Patients assigned to the immediate-resuscitation group received standard fluid resuscitation before they reached the hospital and in the trauma center, and those assigned to the delayed-resuscitation group received intravenous cannulation but no fluid resuscitation until they reached the operating room.

Results. Among the 289 patients who received delayed fluid resuscitation, 203 (70 percent) survived and were discharged from the hospital, as compared with 193 of the 309 patients (62 percent) who received immediate fluid resuscitation ($P = 0.04$). The mean estimated intraoperative blood loss was similar in the two groups. Among the 238 patients in the delayed-resuscitation group who survived to the postoperative period, 55 (23 percent) had one or more complications (adult respiratory distress syndrome, sepsis syndrome, acute renal failure, coagulopathy, wound infection, and pneumonia), as compared with 69 of the 227 patients (30 percent) in the immediate-resuscitation group ($P = 0.08$). The duration of hospitalization was shorter in the delayed-resuscitation group.

Conclusions. For hypotensive patients with penetrating torso injuries, delay of aggressive fluid resuscitation until operative intervention improves the outcome. (N Engl J Med 1994;331:1105-9.)

"Injection of a fluid that will increase blood pressure has dangers in itself…

If the pressure is raised before the surgeon is ready to check any bleeding

that might take place,

blood that is sorely needed may be lost."

- ***Walter Cannon, 1918***

JAMA

Permissive hypotension

- Goal = maintain vital organ perfusion NOT necessarily a normal blood pressure
- Adequate perfusion: presence of a radial pulse or normal mental status
- Small trials of fluid with reassessment
- Avoids "cyclic" over resuscitation

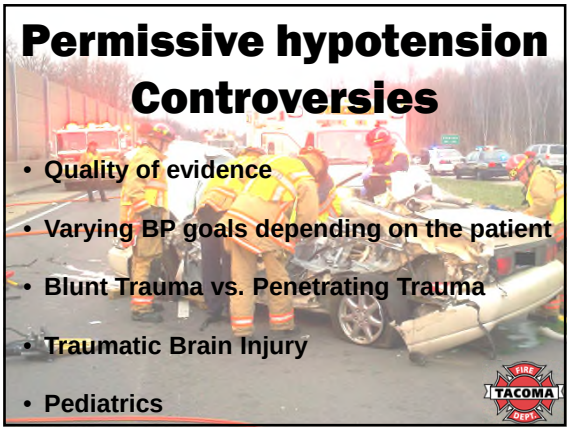
"Don't Pop the Clot"

- ↑ BP = ↑ pressure on a delicate clot
- ↑ intravascular volume stretches vessel & places tension on the clot
- ↑ intravascular volume stretches vessel and may expand the size of the hole

Permissive hypotension

- Primarily applicable to penetrating trauma
- Part of "Damage Control Resuscitation" & "Damage Control surgery"
- Remains somewhat controversial

Permissive hypotension Controversies



- Quality of evidence
- Varying BP goals depending on the patient
- Blunt Trauma vs. Penetrating Trauma
- Traumatic Brain Injury
- Pediatrics

Guidelines for Prehospital Fluid Resuscitation in the Injured Patient

Bryan A. Cotton, MD, MPH, Rebecca Jerome, MLIS, MPH, Bryan R. Collier, DO, Suneel Khetarpal, MD, Michelle Holevar, MD, Brian Tucker, DO, Stan Kurek, DO, Nathan T. Mowery, MD, Kamalesh Shah, MD, William Bromberg, MD, Oliver L. Gunter, MD, and William P. Riordan, Jr., MD; EAST Practice Parameter Workgroup for Prehospital Fluid Resuscitation

1. IV access enroute (Consider IO placement)
2. Fluids should be withheld in patients who are alert or have a palpable radial pulse
3. Fluids should be given in 250ml boluses to restore a radial pulse or mental status
4. In TBI, fluids should be titrated to maintain SBP > 90mmHg

east Eastern Association for the Surgery of Trauma
Advancing Science, Fostering Relationships, and Building Careers

Fluid Resuscitation for Hemorrhagic Shock in TCCC

- Reassess the casualty after each 500ml bolus
- Continue resuscitation until a palpable radial pulse, improved mental status, or systolic BP of 80-90mmHg is present
- Discontinue fluid administration when one or more of the above end points has been achieved.

Early Use of Vasopressors After Injury: Caution Before Constriction

Jason L. Sperry, MD, MPH, Joseph P. Minei, MD, Heidi L. Frankel, MD, Micheal A. West, MD, PhD, Brian G. Harbrecht, MD, Ernest E. Moore, MD, Ronald V. Maier, MD, and Ram Nirula, MD, MPH

Objective: Recent evidence suggests that overly aggressive crystalloid resuscitation is associated with poor outcome. This has led to a renewed interest in the use of vasopressors for hemodynamic support during resuscitation after injury. We sought to characterize early vasopressor (EV) use and aggressive early crystalloid resuscitation (ECR) and their association with mortality in severely injured patients.

Methods: Data were obtained from a multicenter, prospective, cohort study designed to evaluate the outcome of blunt injured adults in hemorrhagic shock. Early deaths (<48 hours) were excluded from the analysis. A single Cox proportional hazard regression model was used to evaluate the effects of EV use (levophed, phenylephrine, dopamine, or vasopressin) and aggressive ECR on mortality at 12 and 24 hours postinjury, while controlling for important physiologic, injury, resuscitation, and patient demographic confounders.

Results: Cox proportional hazard regression revealed that EV use within 12 hours after injury was independently associated with over an 80% higher risk of mortality (hazard ratio [HR] 1.81, 95% confidence interval [CI] 1.1–2.9, $p = 0.013$), and was independently associated with over a twofold higher risk of mortality at 24 hours (HR 2.15, 95% CI 1.4–3.4, $p = 0.001$). These findings were consistent across all vasopressor subtypes. Aggressive ECR was independently associated with a 40% reduction in mortality (HR 0.592, 95% CI 0.37–0.95, $p = 0.030$).

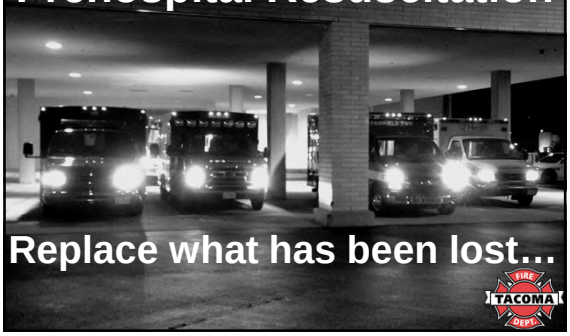
Conclusion: These findings provide evidence that the early use of vasopressors for hemodynamic support after hemorrhagic shock may be deleterious, and should be used cautiously and not in place of aggressive crystalloid resuscitation after severe blunt injury.

Key Words: Vasopressor therapy, Crystalloid resuscitation, Cox proportional hazard regression.

J Trauma. 2008;64:9–14.

Early use of vasopressors should <u>NOT</u> be used in place of fluid resuscitation after significant injury

The Future of Prehospital Resuscitation



Replace what has been lost…

DAMAGE CONTROL RESUSCITATION

- <u>Bundle of interventions/strategies</u> designed to
  1. Minimize blood loss
  2. Maximize tissue oxygenation
  3. Optimize Outcome

DAMAGE CONTROL RESUSCITATION

- Goal is to *"keep up **NOT** catch up"*
- **Components**
  1. Permissive Hypotension
  2. Hemostatic Resuscitation:
     - ✓ minimize IV fluids & maximize blood products 1:1:1
  3. Damage Control Surgery

DAMAGE CONTROL RESUSCITATION


Article

Damage Control Resuscitation

James N. Bogert, MD[1], John A. Harvin, MD[1], and Bryan A. Cotton, MD, MPH[1]

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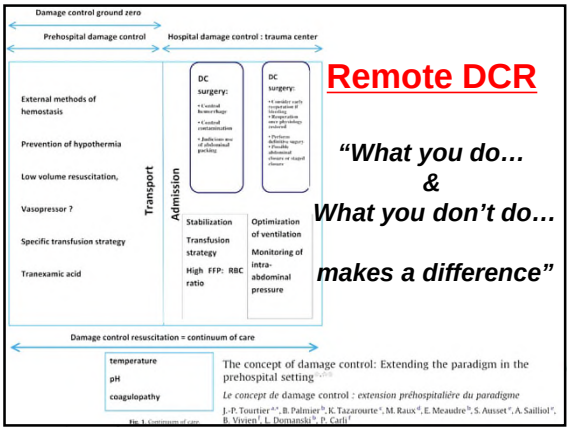
"Conceptually, DCR can be thought of as the preemptive treatment of the lethal triad…"

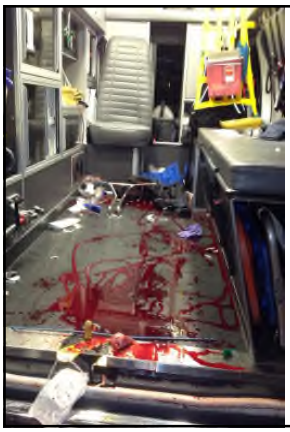
To truly achieve benefit from DCR, early initiation of these techniques is critical.."



Remote DCR

"What you do…
&
What you don't do…

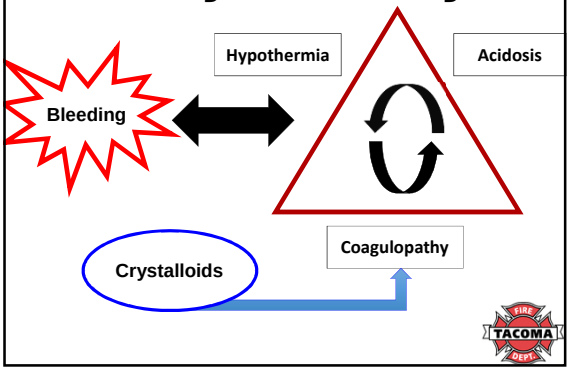
makes a difference"



Think back to your last critical trauma patient…

How did you do?

"A Bloody Vicious Cycle"



Tenets of the Triad

- It **STARTS** with bleeding…
- It **ENDS** with death…
- You can **NOT** predict when it will occur & how severe it will be…
- Once started it **WILL** spiral out of control

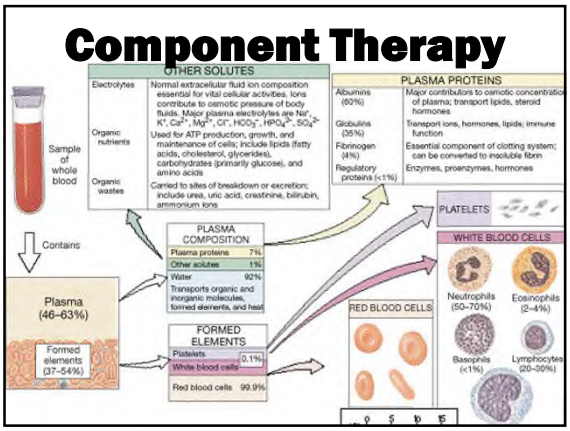
Tenets of the Triad

- There is much that **YOU** can do…
- It takes preparation and practice
- Do **NOT** forget what you can **NOT** see
- Great advances have been made and even more are to come…

Fresh Whole Blood

- Replaces exactly what was lost… ***"The ideal fluid"***
- Preferred by the military
- Limited outside of military and disaster setting

Component Therapy



Plasma

- Contains clotting factors and…
  - ✓Reverses endothelial cell permeability
  - ✓Improves inflammation assoc with injury
  - ✓Improves platelet function & clot strength
  - ✓In large animal studies, plasma resuscitation has been shown to reduce TBI
- Early administration improves survival

COMBAT Research Study

- Sponsored by U.S. DOD
- Randomize injured patients to receive 2 units of plasma versus standard IV fluids by EMS
  - SBP < 70mmHg or SBP < 90 with HR > 108
- Evaluate 24 hour and 28 day mortality

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PLASMA FIRST IN THE FIELD FOR POSTINJURY HEMORRHAGIC SHOCK

Ernest E. Moore,*† Theresa L. Chin,† Michael C. Chapman,† Eduardo Gonzalez,*† Hunter B. Moore,*† Christopher C. Silliman,† Kirk C. Hansen,† Angela Sauaia,*† and Anirban Banerjee†

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COMBAT Research Study

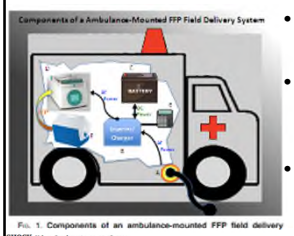

FIG. 1. Components of an ambulance-mounted FFP field delivery

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- Plasma thawed in 2.5 min
- Cost per ground ambulance $13,000
- Study complete Dec 2017

Pre-Hospital Use of Plasma for Traumatic Hemorrhage (PUPTH)

- Sponsored by U.S. Army
- Randomize injured patients to receive 2 units of thawed type A plasma versus standard NS by EMS
  - SBP < 70mmHg or SBP < 90 with HR > 108
- Administered by supervisor QRV with refrigerator
- Evaluate 30 day mortality

VCU Medical Center

Dried Plasma

- Previously used by U.S. Military in WWII
- German, French, & Israeli Defense Force pioneered the process in recent years
- FDA approved for U.S. Special Forces under limited contingency circumstances in Afghanistan

Dried Plasma

- Can be stored at ambient temperatures
- Long shelf life (15-24 months)
- Reconstitute with 200ml water in 5-10 min
- Lab data demonstrates that it maintains global capacity to induce clot formation

- Strong safety profile
- Limited prehospital data

Review Article

FREEZE-DRIED PLASMA AT THE POINT OF INJURY: FROM CONCEPT TO DOCTRINE

Elon Glassberg,*† Roy Nadler,*† Sami Gendler,*† Amir Abramovich,*† Philip C. Spinella,‡§ Robert T. Gerhardt,¶ John B. Holcomb,‖ and Yitshak Kreiss*†

SHOCK

ISRAEL DEFENSE FORCES MEDICAL CORPS

- IDF has distributed to all ALS providers in 2013
- Replaces crystalloid resuscitation at point of injury
- Criteria designed to avoid over treatment
- Caution after 3 units…

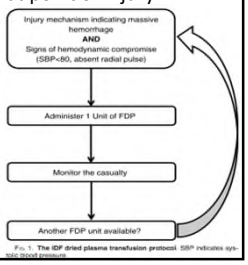

FIG. 1. The IDF dried plasma transfusion protocol. SBP indicates systolic blood pressure.

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An Evidence-based Prehospital Guideline for External Hemorrhage Control: American College of Surgeons Committee on Trauma

Eileen M. Bulger, MD, FACS, David Snyder, PhD, Karen Schoelles, MD, FACP, Cathy Gotschall, ScD, Drew Dawson, BA, Eddy Lang, MD, CM CCFP (EM) CSPQ, Nels D. Sanddal, PhD, NREMT, Frank K. Butler, MD, FAAO, FUHM, Mary Fallat, MD, FACS, Peter Taillac, MD, Lynn White, MS, CCRP, Jeffrey P. Salomone, MD, FACS, NREMT-P, William Seifarth, MS, NREMT-P, Michael J. Betzner, MD, FRCPC, Jay Johannigman, MD, FACS, Norman McSwain, Jr., MD, FACS, NREMT-P

2014

Topical Hemostatic Agents

Recommendation 1: We suggest the use of topical hemostatic agents, in combination with direct pressure, for the control of significant hemorrhage in the prehospital setting in anatomic areas where tourniquets cannot be applied and where sustained direct pressure alone is ineffective or impractical.

Strength of Recommendation: Weak

Recommendation 2: We suggest that topical hemostatic agents be delivered in a gauze format that supports wound packing.

Strength of Recommendation: Weak

Recommendation 3: Only products determined effective and safe in a standardized laboratory injury model should be used.

Strength of Recommendation: Weak

Additional Training Recommendations

- We advise that tourniquets and topical hemostatic agents be used under clinical practice guidelines and following product specific training.
- We advise that hemostatic agent training for prehospital personnel include proper wound packing and pressure application techniques.
- We advise that tourniquets and topical hemostatic agents use be expanded to include all prehospital personnel, including emergency medical responders (in concordance with the Hartford Consensus Statement[9]).

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Tourniquets

Recommendation 1: We recommend the use of tourniquets in the prehospital setting for the control of significant extremity hemorrhage if direct pressure is ineffective or impractical.

Strength of Recommendation: Strong

Remarks: The panel believes that tourniquets used to treat severe extremity hemorrhage have a clear survival benefit, demonstrated by a large and consistent effect size across several studies. The panel discussed that direct pressure may be ineffective in the setting of major arterial injury or impractical in circumstances with limited manpower, unsecure scene, or when complex extrication or extraction is required.

Recommendation 2: We suggest using commercially produced windlass, pneumatic, or ratcheting devices that have been demonstrated to occlude arterial flow.

Strength of Recommendation: Weak

Recommendation 3: We suggest against the use of narrow, elastic, or bungee-type devices.

Recommendation 4: We suggest that improvised tourniquets be applied only if no commercial device is available.

Strength of Recommendation: Weak

Recommendation 5: We suggest against releasing a tourniquet that has been properly applied in the prehospital setting until the patient has reached definitive care.

Strength of Recommendation: Weak

REMEMBER

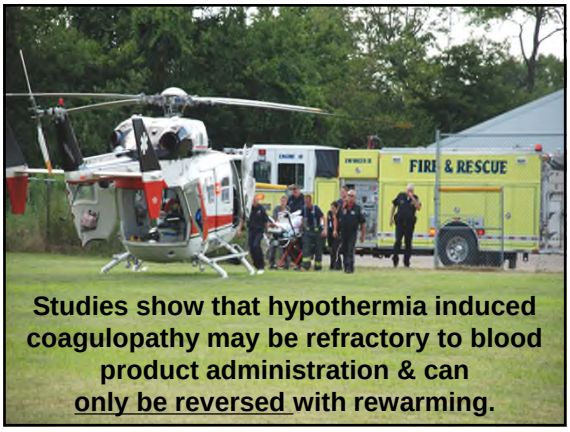
- Only 6-8% of trauma pts have immediate hypotension
- 1/3 is from causes other than blood loss
  - ✓ Pneumothorax
  - ✓ Drug ingestion
  - ✓ Medical illness

MISSION CRITICAL

Through action & Inaction

TRAUMA

A very real difference can be made…



Studies show that hypothermia induced coagulopathy may be refractory to blood product administration & can only be reversed with rewarming.

Hypothermia

Traditional Classification of Hypothermia versus Revised Classification for Trauma Patients

Degree of hypothermia	Traditional Classification (° C)	Trauma Classification (° C)
Mild	32-35	34-36 (93.2-96.8° F)
Moderate	28-32	32-34 (89.6-96.8° F)
Severe	20-28	< 32 (89.6° F)
Profound	14-20	
Deep	< 14	