Salt Water & Red Stuff:

Trauma Resuscitation Best Practices

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What Is Shock?

A rude unhinging of the machinery of life

(Samuel Gross, 1872)

What Is Shock?

A momentary pause in the act of death

(John Collins Warren, 1895)

General Definition of Hemorrhagic Shock

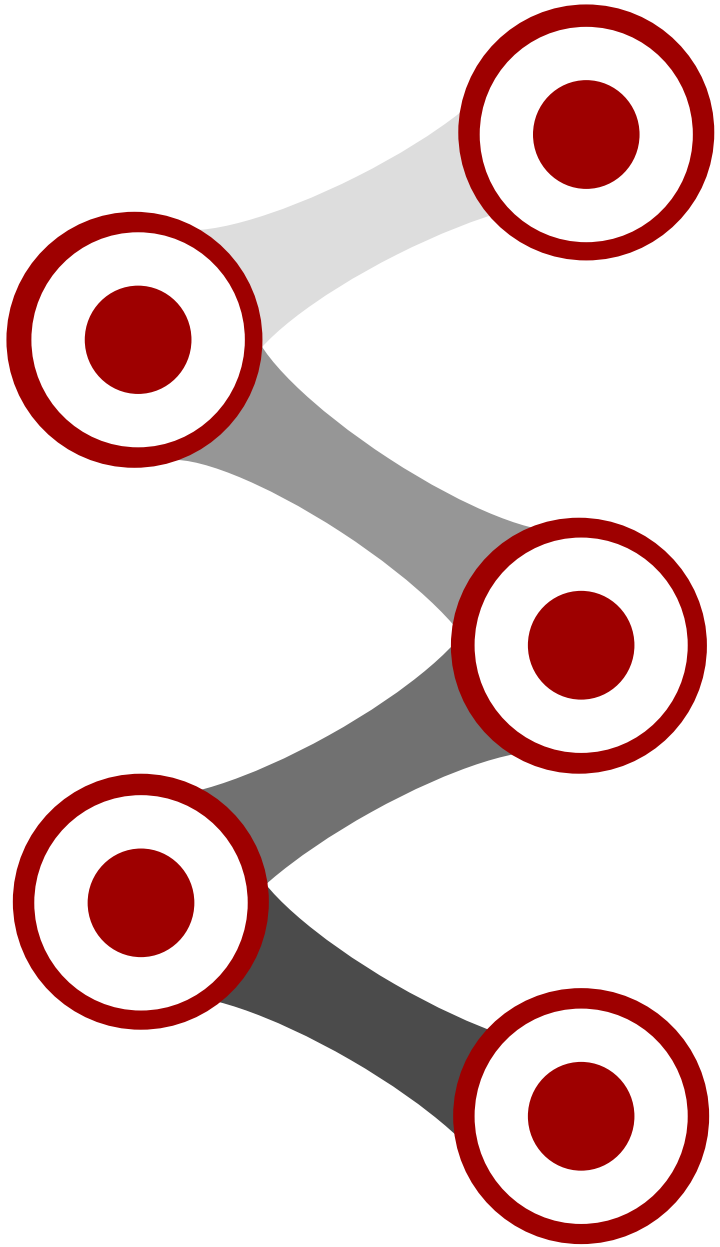
A clinical state resulting from decreased blood and oxygen perfusion of vital organs secondary to a loss of circulating blood volume.

“Blood Failure”

White et al, JTACS 2017

Arterial Pressure

Blood Loss



Baroreceptors
Chemoreceptors
Humoral Pathways

Epinephrine
Norepinephrine
Renin

SVR
HR
CO
Vascular Volume

EAST Clinical Practice Guidelines

Standard hemodynamic parameters do not adequately quantify the degree of physiologic derangement in trauma patients.

The time to normalization of base deficit, lactate, and pH is predictive of survival. Observation of at least one of these parameters should be used clinically for prognostication.

Tisherman et al, 2004

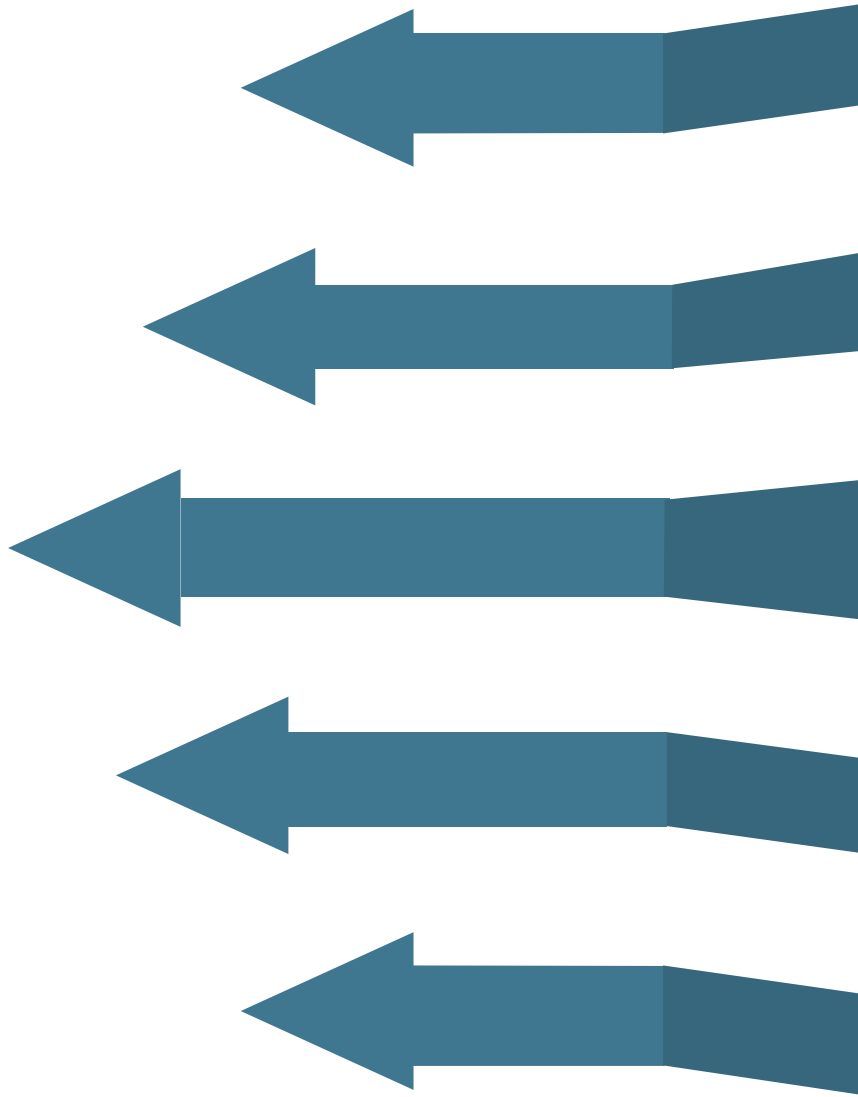
Lactic Acid

Biochemical marker of cellular hypoxia

Sensitive for Hemorrhagic Shock

Removed from circulating volume via treatment and restored perfusion

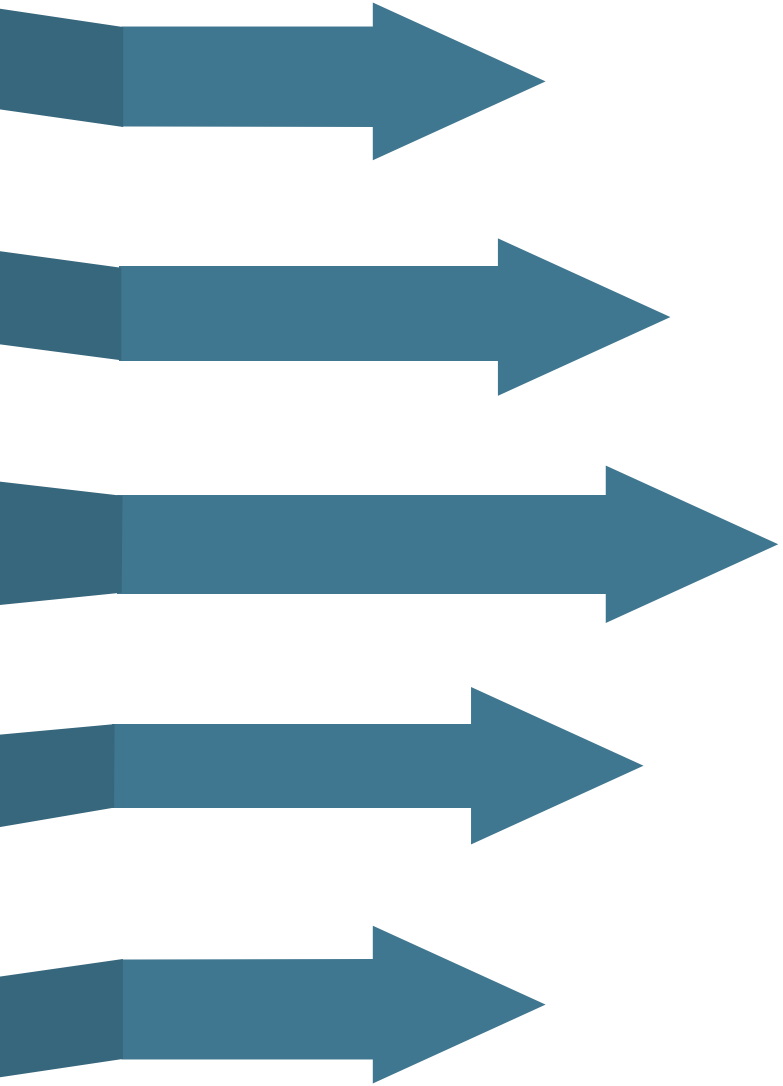
Not Specific for Hemorrhagic Shock



Initial lactate strongly correlates with mortality

Among patients with an initially elevated lactate (≥4.0 mg/dL), lower lactate clearance at 6 hours strongly and independently predicted an increased risk of death

(Odom et al, JTACS 2013)



Base Deficit

Amount of base needed to titrate 1L blood to a pH of 7.4

- Indicates an excess of acid

Sensitive for Hemorrhagic Shock

Normalizes rapidly with adequate resuscitation

Not Specific for Hemorrhagic Shock

Initial base deficit levels and time to normalization of these levels correlate well with need for transfusion and risk of MODS and death.

Persistently high or worsening base deficit levels may be an early indicator of complications

(Tisherman et al, 2004)

Putting the puzzle together

CONGRATULATIONS

You have diagnosed hemorrhagic shock

NOW WHAT ??

SALT WATER

NO Oxygen Carrying Capacity

Contributory to an Acidotic State

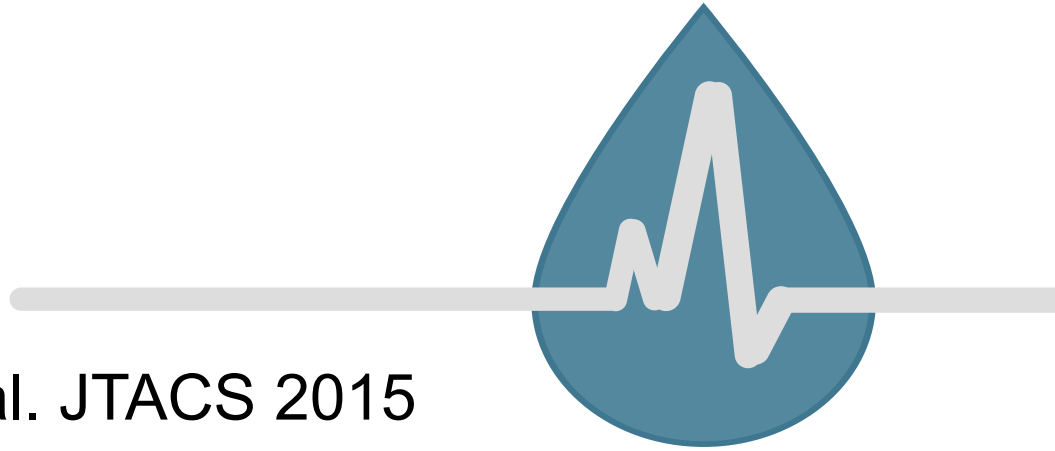
Does **NOT** Remain in the Intravascular Space

Vasodilation

Does **NOT** Restore Hemostatic Potential

Dilutional Coagulopathy

"The historic role of crystalloid and colloid solutions in trauma resuscitation represents the triumph of hope and wishful thinking over physiology and experience"



Cap et al. JTACS 2015

Controlled Resuscitation
VS
Standard Resuscitation

Schreiber et al, 2015
192 patients

(CR) 250ml aliquots of crystalloid for no radial pulse or SBP<70

(SR) 2L crystalloid +fluid needed to maintain SBP≥110

1L fluid Vs 2L fluid for CR vs SR

24-hour mortality in blunt trauma was 3%(CR) vs 18%(SR)

TANK FILLER

NOT AN OXYGEN GIVER


TANK FULL
=
INCREASED BLOOD PRESSURE


INCREASED BLOOD PRESSURE
≠
ADEQUATE
OXYGENATION

RED STUFF

GIVE EM' WHAT THEY'VE LOST

Massive Transfusion Protocols

Balanced Resuscitation

Whole Blood

Whole Blood

Old School is Now New School

Whole blood was the preferred resuscitative fluid from WW1 through the Vietnam War

Whole Blood

1960-1970's

Shift from WB to crystalloid + component therapy (predominantly PRBC's) without supporting evidence

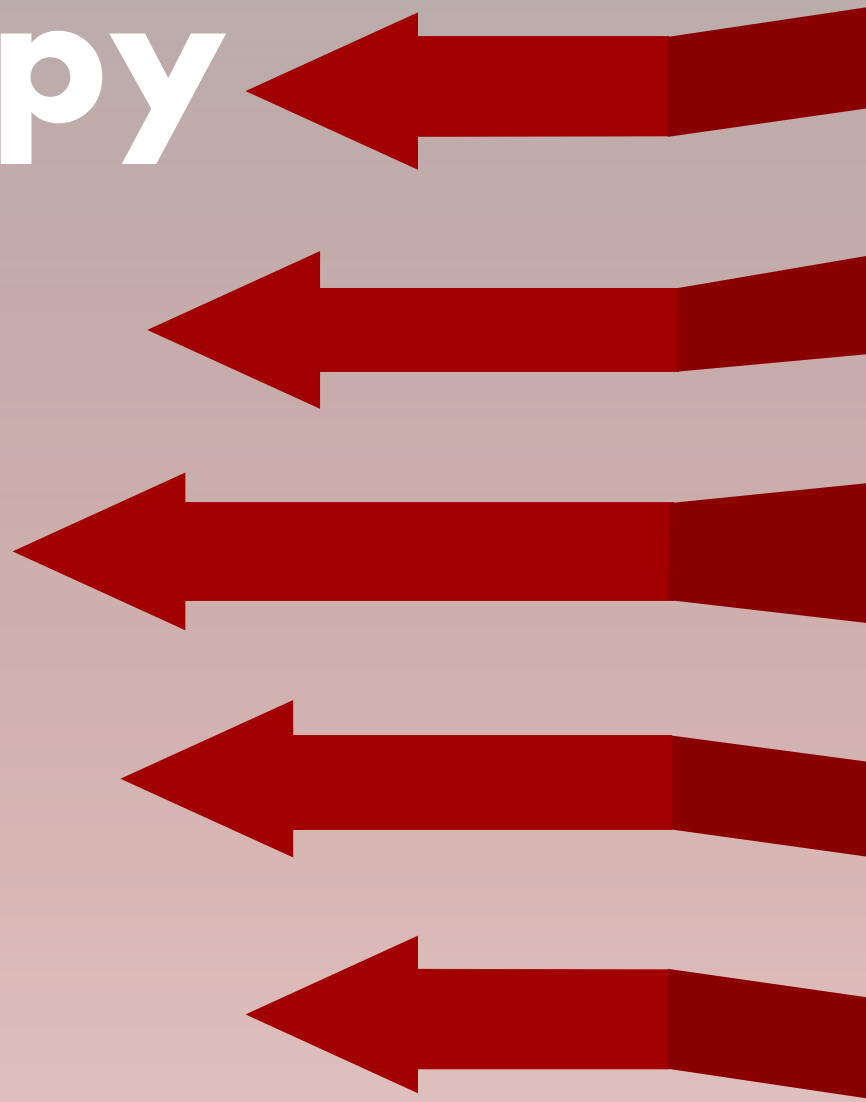
Whole Blood

1:1:1 Component Therapy

≠

One Unit Whole Blood

Whole Blood Vs Component Therapy



1:1:1 Component Therapy

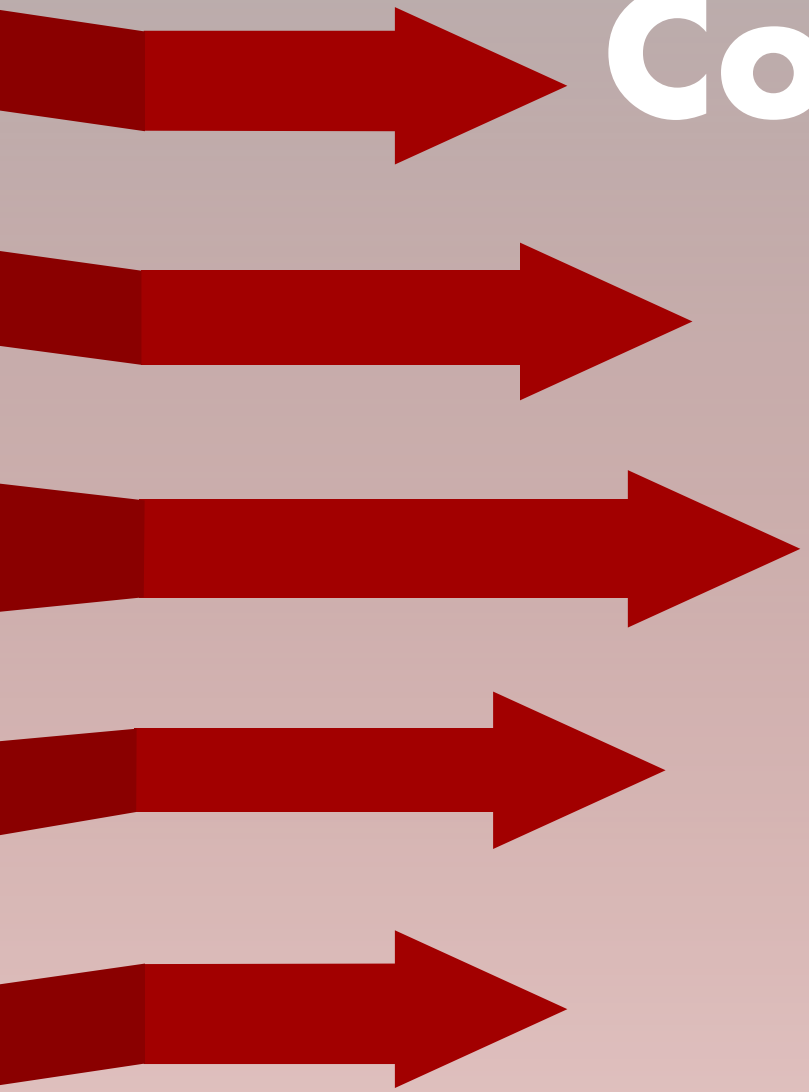
≈

HCT 29%

Platelets 88×10^9

Coagulation Factor Activity 65%

Whole Blood Vs Component Therapy



Whole Blood

≈

HCT 38-50%

Platelets 150-400x10^9

Coagulation Factor Activity 100%

ALL BLEEDING STOPS...

EVENTUALLY

ALL BLEEDING STOPS...

IF YOU LET IT

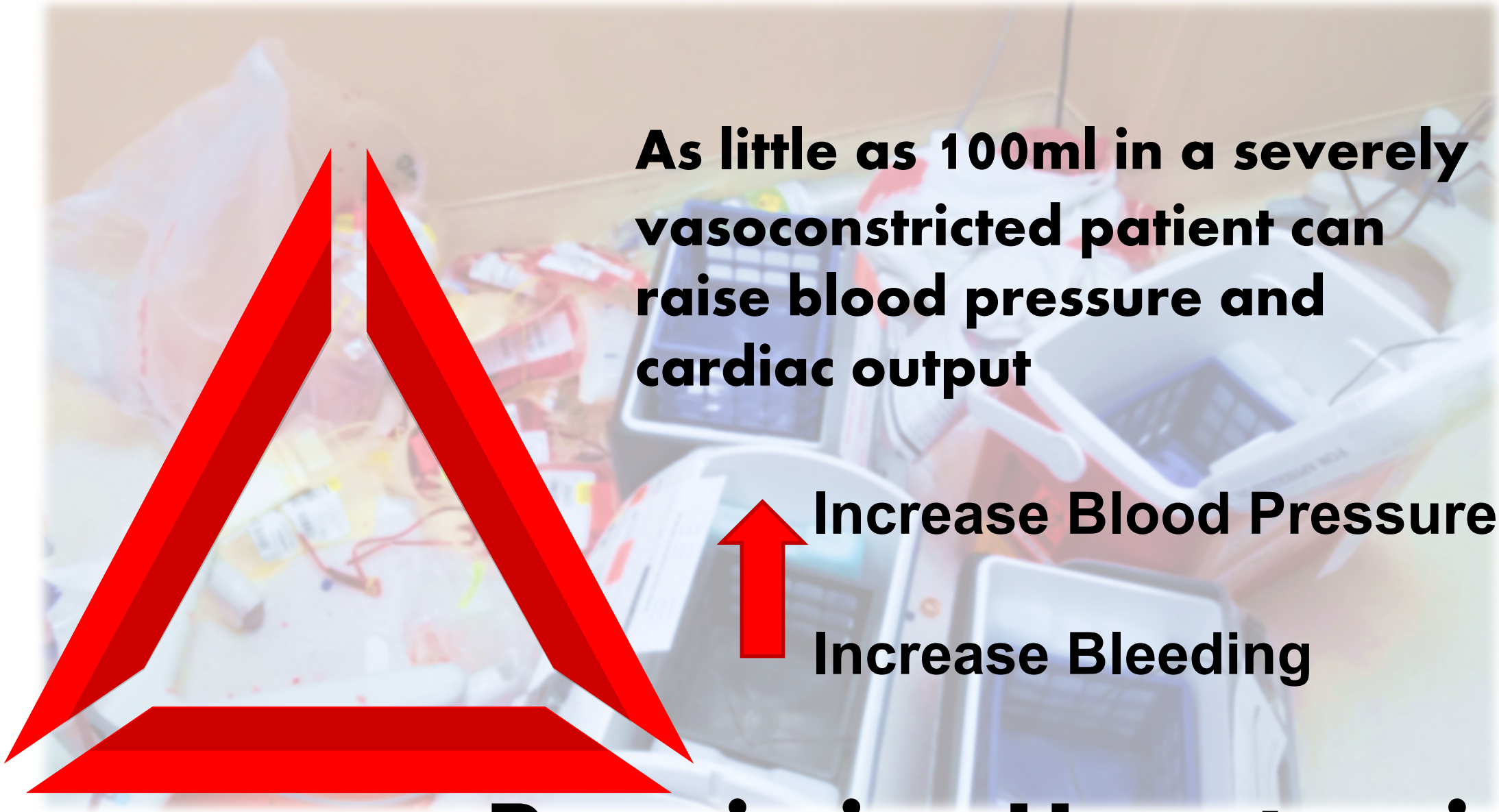
ALL BLEEDING STOPS...

Damage Control Resuscitation

Permissive Hypotension

Damage Control Resuscitation


Stop The Flow
Keep Them Low
Permissive Hypotension



As little as 100ml in a severely vasoconstricted patient can raise blood pressure and cardiac output

Increase Blood Pressure

Increase Bleeding

Permissive Hypotension

Damage Control Resuscitation

THE TRAUMA TRIAD OF DEATH

Coagulopathy

- Acute Traumatic Coagulopathy
- Consumptive
- Dilutional

Acidosis

- Hypoperfusion
- Blood Loss
- Inadequate 0_2 Delivery

Hypothermia

- Exposure, Unwarmed Fluids, Blood Loss

THE TRAUMA TRIAD OF DEATH

THE TRAUMA TRIAD OF DEATH

Coagulopathy

- TEG/ROTEM to Guide Ratios
- FFP
- Platelets
- Cryoprecipitate
- Treat Acidosis
- TXA
- Limit Salt Water
- Keep em' Warm

Acidosis

- Stop The Bleed
- Give Blood
- Correct Oxygen Debt
- Limit Salt Water
- Keep em' Warm

Hypothermia

- Warm EVERYTHING

RECAP

Assess like your patient's life depends on it

If it does not clot or carry oxygen don't give it

Stop the flow, Keep em' low

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