



Damage control Resucitation

By

Dr.Fahd Y Haddad

Emergency medicine resident

- **Hemorrhage** accounts for 40% of all trauma-associated deaths.
- **Damage control resuscitation (DCR)** is a treatment strategy that targets the conditions that exacerbate hemorrhage in trauma patients.
- Topics reviewed and discussed will include **DCR** and **surgery, transfusion ratios, permissive hypotension, recombinant factor VIIa (rFVIIa), hypertonic fluid solutions**, and the destructive forces of **hypothermia, acidosis**, and **coagulopathy**.

- DCR differs from current resuscitation approaches by attempting an **earlier and more aggressive correction of coagulopathy and metabolic derangement.**
- DCR centers on the application of several key concepts, the **permissive hypotension**, the use of **blood products** over isotonic fluid for volume replacement, and the rapid and early **correction of coagulopathy** with component therapy.

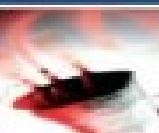
The Lethal Triad

Acidosis

Hypothermia

Death

Coagulopathy



PERMISSIVE HYPOTENSION

- Keep the blood pressure low enough to avoid exsanguination while maintaining perfusion of end organs.
- 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 bleeding, blood that is sorely needed may be lost.

Endpoint of resuscitation before definitive hemorrhage control was a **systolic pressure of 70 to 80 mmHg**, using a crystalloid/ colloid mixture as his fluid of choice.

Cannon WB. JAMA. 1918;70:618.

“When the patient must wait for a considerable period, elevation of his **SBP to 85 mmHg is all that is necessary** ... and when profuse internal bleeding is occurring, it is wasteful of time and blood to attempt to get a patient's blood pressure up to normal. One should consider himself lucky if a systolic pressure of 80 to 85 mmHg can be achieved and then surgery undertaken.”

Beecher HK. U.S. Government Printing Office; 1952:6

ISOTONIC CRYSTALLOIDS

Isotonic fluid administration in large boluses for acute hemorrhagic loss or severe traumatic injury requiring massive transfusion is the optimal therapy.



- Crystalloids can cause **dilutional coagulopathy** and do little for the oxygen carrying capacity needed to correct anaerobic metabolism and the oxygen debt associated with shock.
- The use of unwarmed fluids can also be implicated as a major cause for **hypothermia**.
- Crystalloids have been associated with **hyperchloremic acidosis** and the worsening of trauma patients existing acidosis.
- Isotonic, hypotonic, and colloid solutions given post-injury have been shown to leak and cause edema with only a fraction remaining within the intravascular system.

TRAUMA

Hemorrhage

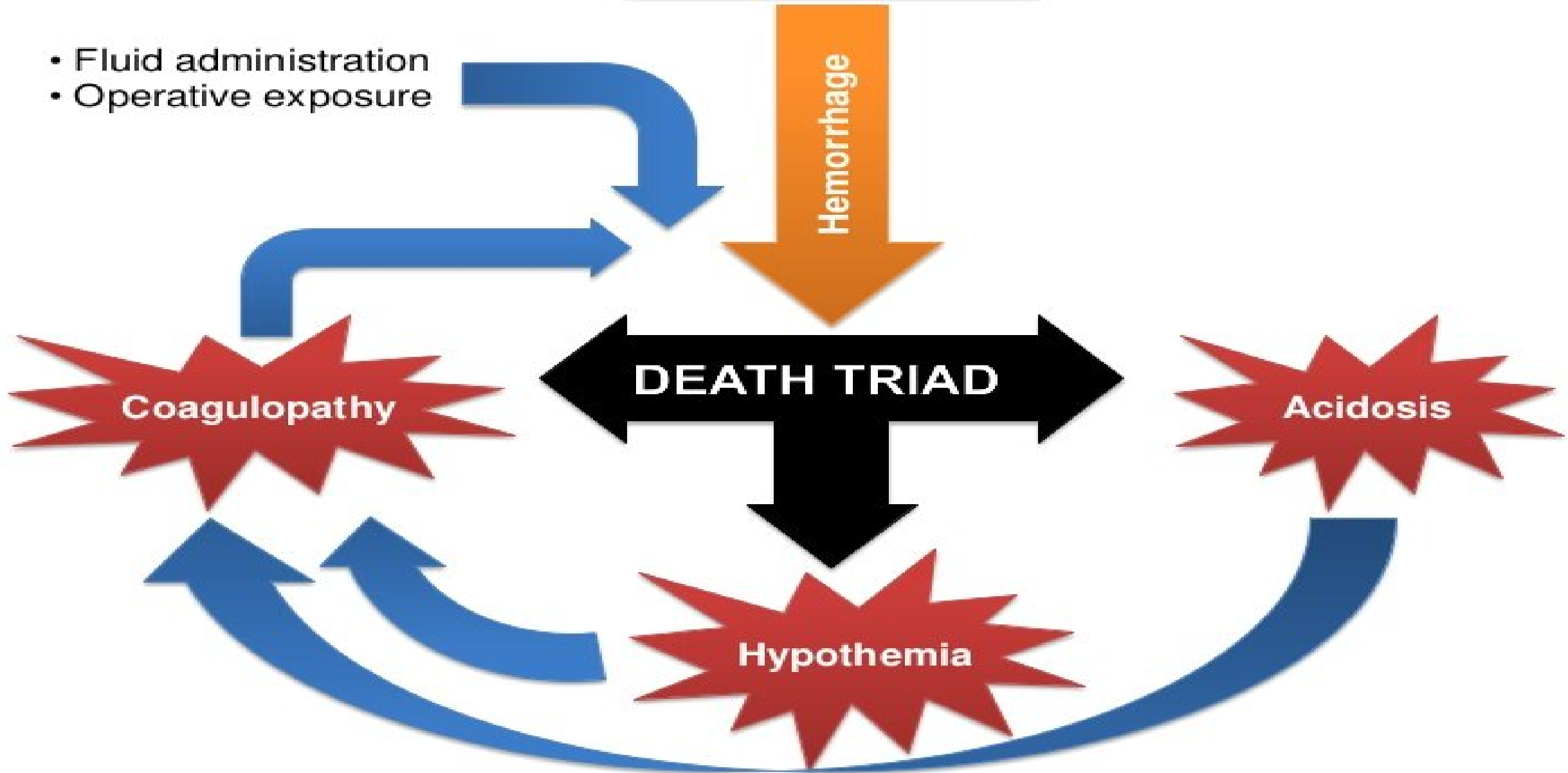
- Fluid administration
- Operative exposure

DEATH TRIAD

Coagulopathy

Acidosis

Hypothermia



Hypothermia

- Severe hypothermia is associated with a high mortality.
- Most cases of hypothermia
 - **ER:** resuscitation period
 - **OR:** exposure of the peritoneum
- Hypothermic patients were hypocoagulable with body temperatures < **34.0°C**

Acidosis

- Metabolic acidosis is the predominant physiologic defect resulting from persistent hypoperfusion.
- Acidosis at **pH < 7.2** is associated with decreased contractility and cardiac output, vasodilation, hypotension, bradycardia, increased dysrhythmias, and decreased blood flow to the liver and kidneys.
- Acidosis can also act synergistically with hypothermia in its detrimental effect on the coagulation cascade.

TRAUMA-INDUCED COAGULOPATHY

The coagulopathy of trauma is one of the single most accurate predictors of prognosis in trauma and is one of the most significant challenges to any DCR effort.

- In severely injured patients, coagulopathy can be exacerbated during initial care, resuscitation, and stabilization.
- More than **5 units of pRBC** will lead to a **dilutional coagulopathy**, that prolongation of the PT was a sentinel sign of dilutional coagulopathy, and that this phenomenon occurs early.

Early Identification of Shock

- The combination of **altered mental status**, **cool/clammy skin**, and an **absent radial pulse** is a well-established triad, indicating hypovolemic shock.
- When examining vital signs, the **shock index** (**SI= HR/SBP**) is a better indicator of shock than hypotension and is more sensitive than individual vital signs analysis.
- Laboratory findings indicative of hypoperfusion include **bicarbonate**, **base deficit**, and **lactate**.

ABC Scoring

1. Penetrating mechanism
2. Positive FAST
3. SBP $\leq$ 90 mmHg on arrival
4. Heart rate $\geq$ 120 bpm on arrival

Score $\geq$ 2 is 75% sensitive and 86% specific for predicting massive transfusion

**Early prediction of massive transfusion in trauma:
Simple as ABC (assessment of blood consumption)?
J Trauma. 2009;66:346–352.**

The background image shows medical equipment, including a stethoscope and several white labels with black barcodes, all resting on a red surface. A semi-transparent dark grey horizontal band is positioned across the middle of the image, containing the text 'DAMAGE CONTROL RESUSCITATION' in white, bold, sans-serif capital letters.

DAMAGE CONTROL RESUSCITATION

Resuscitation With FFP

- Hewson et al. recommended that **FFP and pRBCs be given at a ratio of 1:1**

Crit Care Med. 1985;13:387–391.

- Hirshberg et al. concluded that to avoid coagulopathy, **RBCs and FFP must be given in a 3:2 ratio.**

J Trauma. 2003;54:454–463.

- Patients receiving a “high” ratio of **FFP to pRBC (1:1.4)** had the lowest overall mortality rates and hemorrhage-related mortality rates and concluded that high FFP to RBC ratio is independently associated with improved survival to hospital discharge.

J Trauma. 2007;63:805–813.

Resuscitation With Blood

- **Fresh whole blood (FWB)** was historically used in transfusion until it fell out of favor in the middle of the 20th century.
- By the late 1980s, component therapy had almost completely replaced whole blood therapy.

- Theoretically, FWB replaces all the blood components lost to trauma, including platelets and fully functional clotting factors.
In addition, the components of FWB are more functional than their stored counterparts.
- Separating blood into components results in dilution and loss of about half of the viable platelets (88K/L in 1 unit of component therapy vs. 150–400 K/L in 500 mL of FWB), PRBCs (Hct 29% in component therapy vs. 38–50% in FWB), and clotting factors decreasing the coagulation activity of the separated components to 65% when giving a 1:1:1 ratio of component therapy.



DAMAGE CONTROL SURGERY

DAMAGE CONTROL SURGERY

Victims of penetrating torso trauma or multiple blunt trauma with hemodynamic instability are generally better served with abbreviated operations that control hemorrhage allowing for subsequent focus on resuscitation, correction of coagulopathy, and avoiding hypothermia.

Three Phases of Damage Control Surgery

1. Initial operation with hemostasis and packing
2. Transport to the ICU to correct the conditions of hypothermia, acidosis, and coagulopathy
3. Return to the OR for definitive repair of all temporized injuries

Ann Surg. 1988;208:362–370

- In the case of laparotomy, once a damage control approach has been initiated, the initial procedure is directed toward controlling surgical bleeding.
- Bleeding is controlled with either ligation of vessels, balloon catheter tamponade, or packing.

- Splenic and renal injuries are treated with rapid resections, non-bleeding pancreatic injuries are simply drained, and liver injuries are packed.
- The treatment of hollow viscus perforations includes either a simple suture closure or rapid resection of the involved segment.
No anastomoses are performed, and ostomies are not matured.

- At the completion of this portion of the procedure, the patient can either be transported to the ICU or to the interventional radiology suite for **embolization** of arterial hemorrhage that could not be controlled during the open procedure, such as **pelvic fracture** or **liver trauma** involving the arterial circulation.

CONCLUSION

DCR focuses on early, aggressive correction of the components of the lethal triad, hypothermia, coagulopathy, and acidosis.

This strategy must start in the ER and continue through the OR and ICU until the resuscitation is complete.



Thank You

