



Massive Bleeding and Coagulopathy: Definition and Workup

Intended Audience:

Medical Students



Massive Bleeding and Coagulopathy: Definition and Workup

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Suggested Reading

- Coagulopathy of Trauma
 - M Cohen, A Christie
 - Critical Care Clinics 2017;33:101-118

Objectives

- Discuss causes of massive bleeding and classes of hemorrhage
- Discuss the physiologic response to injury relevant to coagulation
- Discuss the development of coagulopathy from traumatic injury and imbalanced resuscitation

Massive Bleeding

- Trauma
- Surgery
 - Planned
 - Un-planned
- GI Bleed
- OB
- Rupture aneurysm



Classes of Hemorrhage

	Class I	Class II	Class III	Class IV
Blood volume lost	<15%	15–30%	30–40%	>40%
Heart rate (bpm)	<100	100–120	120–140	>140
Blood pressure	Normal	Normal	Decreased	Decreased
Pulse pressure	Normal or increased	Decreased	Decreased	Decreased
Respiratory rate	14–20	20–30	30–40	>35
Urine output (mL/hr)	>30	20–30	5–15	Negligible
Mental status	Slightly anxious	Mildly anxious	Anxious, confused	Confused, lethargic

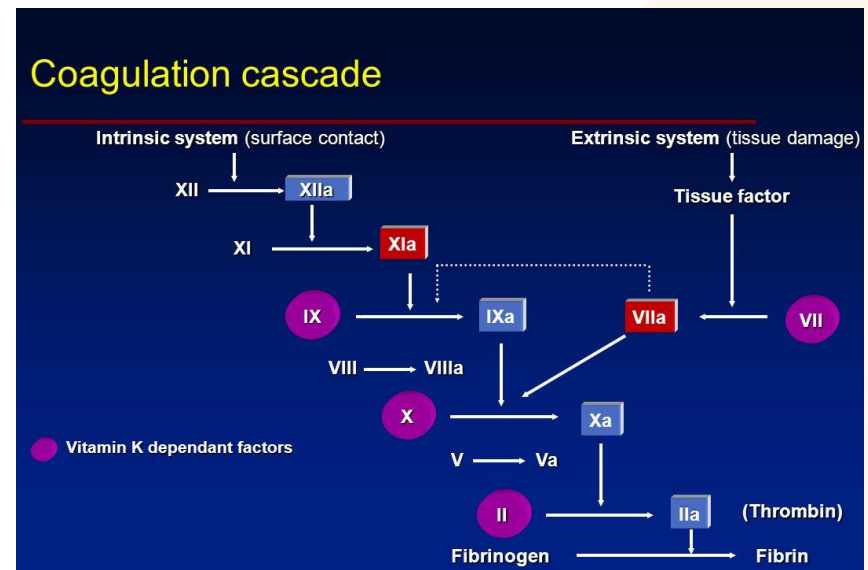
Goal: maintain perfusion to vital organs (brain, heart, lungs), vasoconstrict periphery, splanchnic vessels, injured tissue/vessels

Shock

- Inadequate tissue/end organ perfusion
- Vital signs (HR, BP, RR)
- Mental status
- Urine output
- Lactate, pH, base deficit
- Response to resuscitation (fluid, blood, vasoactive medications)

Physiologic Response to Injury: Coagulation

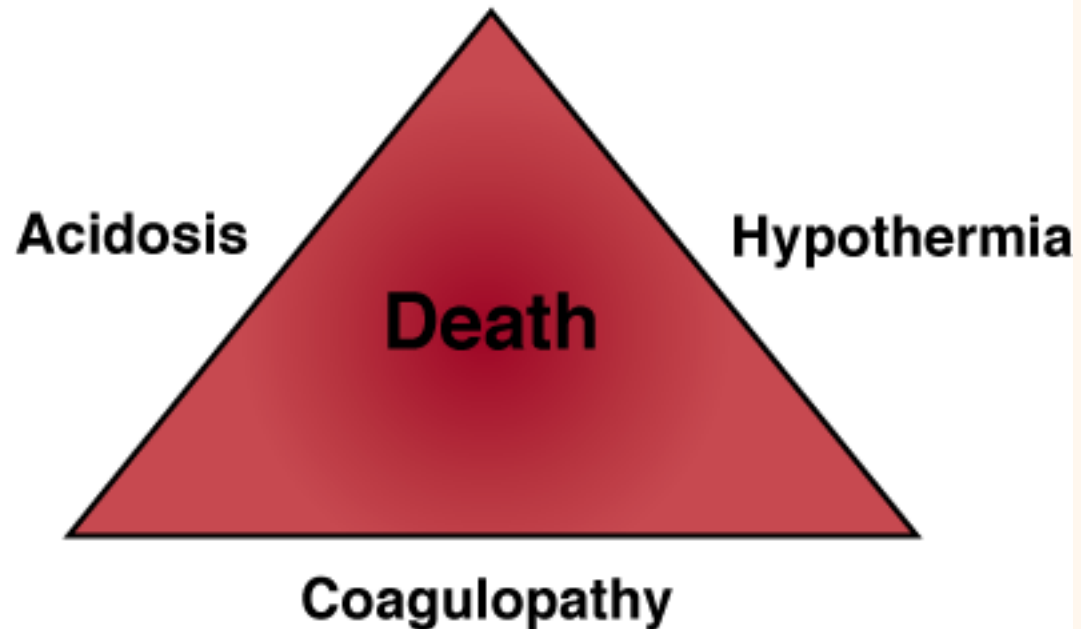
- Tissue injury
 - Trauma
 - Surgery
- Subendothelial tissue factor exposure
- Coagulation cascade
 - Thrombin → Fibrin
 - Crosslinked and combines with platelets
 - Balanced
 - APC; antithrombin; fibrinolysis



Effect of Trauma on Coagulation

The Lethal Triad

- Hemorrhage
 - Hypovolemia
 - Hypercarbia
 - Hypoxia
 - Acidosis
- Tissue edema
- Volume shifts
- Dilution
- Coagulopathy



Source: Mattox KL, Moore EE, Feliciano DV: *Trauma*, 7th Edition: www.accesspharmacy.com

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Lethal Triad

- Metabolic acidosis
 - Inadequate tissue perfusion -> accumulate lactate
 - Large volume normal saline (154mEq Na + Cl)
 - Hyperchloremic metabolic acidosis
 - Inhibits thrombin and factors VIIa, Xa, Va
- Hypothermia (<36 C)
 - Inhibits tissue factor activity, platelet aggregation and adhesion, increase thrombin formation time
 - <33 C: coagulation cascade enzyme inhibition

Trauma Induced Coagulopathy

- 25% of trauma patients
- Tissue injury and shock (tissue hypoperfusion)
- Driven by activation of protein C pathway
- Coagulation inhibition
 - Thrombomodulin
 - Fibrinogen
 - Fibrinolysis

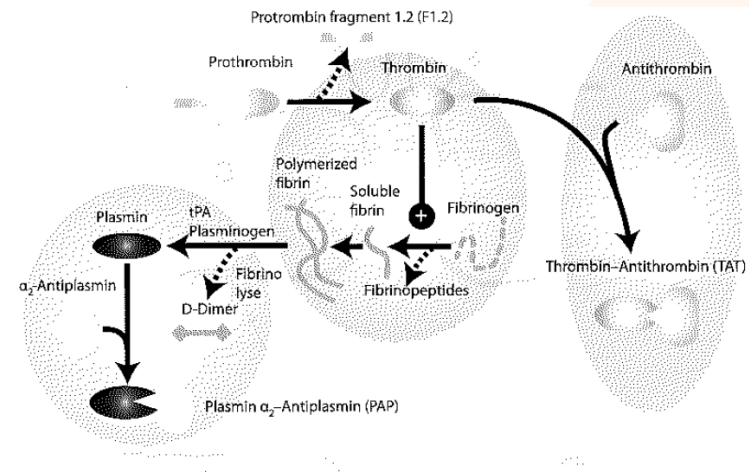


Figure 2-2. Trauma induced coagulopathy driven by activation of the Protein C pathway.

Coagulopathy

- "Non-surgical" bleeding
- Diffuse microvascular hemorrhage
- Dilutional Coagulopathy
 - Excessive crystalloid
 - Imbalance in blood component resuscitation
 - Dilutional loss of clotting factors and platelets
- Acute traumatic coagulopathy
 - Enhanced fibrinolysis
 - Up to 33% trauma patients



Case #1

- A 32 year old man SP MVC presents to ED via ambulance. GCS 7; HR 135; BP 70/40
 - Femur fx splinted
 - CXR with right hemo-pneumothorax, CT placed
 - FAST positive
 - PXR normal
- Discuss how this patient might develop coagulopathy related to traumatic injury

Case #2

- A 32 year old man SP MVC presents to ED via ambulance. GCS 7; HR 135; BP 70/40
 - Normal CXR, PXR, FAST is positive
 - Temperature 36 C
 - BD 8
 - Hg 9
- What type of fluid resuscitation does this patient need? Why?

Case #3

- 79 year old woman fell down 3 steps. Presents to ED via EMS, obtunded and vomiting.
 - GCS 6; HR 70; BP 180/90
 - CXR, PXR, FAST no evidence of trauma
 - PMH: AFIB, CAD; MEDS: Apixaban, ASA, Metoprolol
- How does this patient's medication history contribute to his management?

Case #4

- 23 year old man is shot in the right chest. In the field he has a radial pulse. EMS crews place an IV and give him 2L of IVF during transfer. Upon arrival his initial vital signs are:
 - GCS 13; HR 120; BP 130/90
 - CXR shows moderate right hemothorax, PXR, FAST no evidence of trauma
- During set up for chest tube, his blood pressure drops to SBP 80 and he becomes obtunded. Chest tube is placed and 1500cc blood is returned?
- Discuss with your instructor the concept of hypotensive resuscitation.

Question #1

- 75 year old man with lower GI bleed presents to ICU from ED. He has been having BRBPR since 8am. It is now 6pm. He has had little urine output. He is confused. HR 125; BP 90/75; RR 35. He has 2 large bore IV's in his forearms. You are unable to gather past history or medications from him.
- Of the following lab evaluations, which will provide the most information as to his coagulation profile?
 - a. CBC
 - b. PT/INR
 - c. TEG
 - d. Type and Screen
 - e. ABG

Question #2

- What are the three components of the Lethal Triad of Trauma?
 - a. Hypovolemia, Hypoxia, Acidosis
 - b. Dilution, Coagulopathy, Tissue Edema
 - c. Hypothermia, Hypercarbia, Volume Shifts
 - d. Acidosis, Hypothermia, Coagulopathy
 - e. Thrombomodulin, Fibrinogen, Fibrinolysis

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- Questions?
- Thank you for your time.