Diamonds last forever: Massive Haemorrhage Protocols in Tertiary Academic Centers

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Sunnybrook
HEALTH SCIENCES CENTRE

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- Financial: None
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Objectives

By the end of the talk, attendees will be able to:

1. Understand the relationship between acidosis, hypothermia, coagulopathy and calcium in the bleeding patient requiring mass massive haemorrhage protocol.
2. Understand the prognostic value of fibrinogen level in the bleeding patient requiring massive haemorrhage protocol.
3. Discuss new and emerging therapies related to massive haemorrhage protocols including the use of whole blood.
4. Demonstrate understanding of the role of the nurse within the interprofessional healthcare team in the resuscitation of the bleeding patient requiring massive haemorrhage protocol.

Pre-Test Question #1

Which of the following statements are TRUE?

a) Tranexamic Acid (TXA) can be administered within 24hours of injury
b) Hypothermia has protective effects over the bleeding patient
c) Bleeding control is achieved by hypoperfusing the organs
d) Over half of traumatically injured patients are hypocalcemic

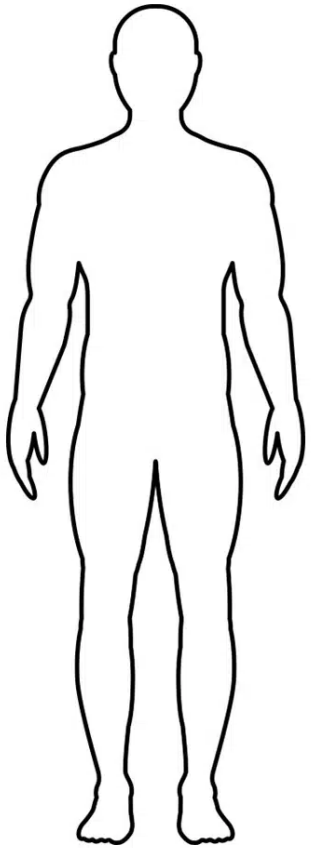
Pre-Test Question #2

Which of the following tests are predictive of need for mass hemorrhage protocol?

a) Fibrinogen
b) PT/INR
c) D-Dimer
d) aPTT

Case Study cont'd: 24F, MVC

- 24-year-old female involved in a motor vehicle accident (single vehicle roll over, wearing seatbelt, extricated from vehicle)
- Initially brought to local community Hospital and stabilized:
  - Decreased LOC
    - Intubated/sedated/ventilated
  - Suspected facial fractures (bilateral periorbital ecchymosis)
  - Multiple rib #'s, hemopneumothorax
    - Bilateral chest tubes for (~400ml)
  - Open fight femur fracture
    - Sager Splint traction
    - Ancef 2g
  - FAST positive
    - Transfused 3U RBC (4th ongoing with paramedics)
    - TXA 1g



Provincial Massive Hemorrhage Toolkit

A comprehensive toolkit was developed to provide guidance for Ontario hospitals in the implementation of Ontario's Recommendations for Massive Hemorrhage Protocol. The toolkit addresses select patient populations and differences in hospital sizes, resources and geographical challenges.

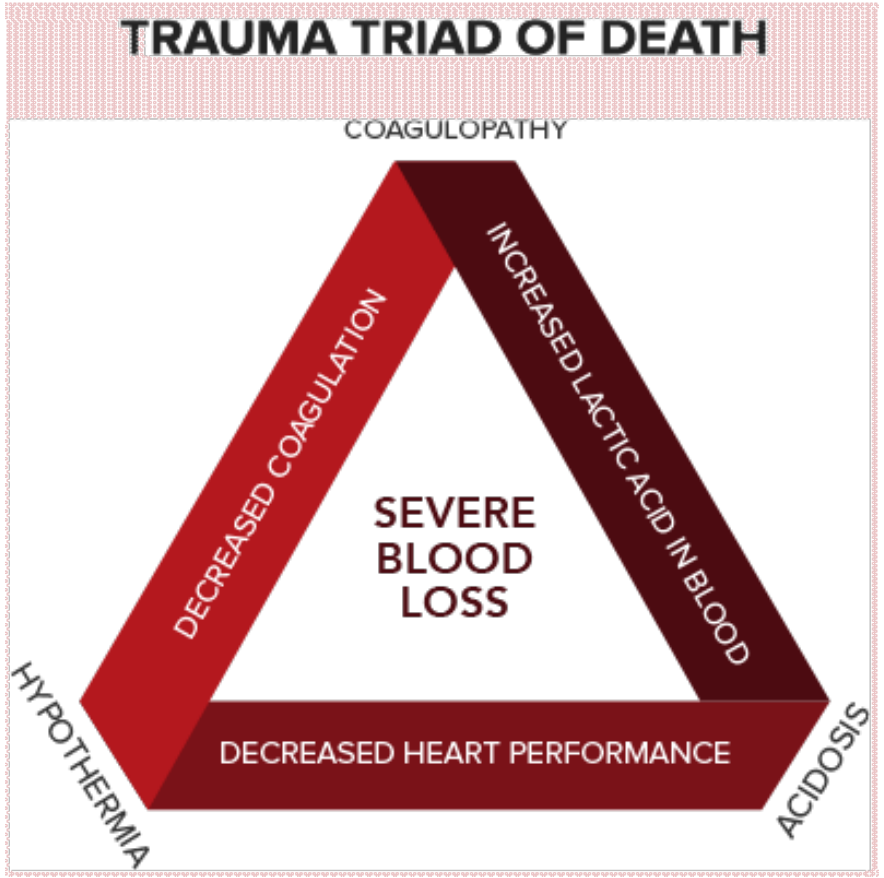
Released April 30, 2021

Read more | View attachment | Download

https://transfusionontario.org/en/category/massive-hemorrhage-protocol/toolkit-mhp/

The 7 T's of MHP

1. **T**rigger the protocol
2. **T**eam preparation and performance
3. **T**ranexamic acid
4. **T**est hourly
5. **T**ransfuse to target
6. **T**emperature management
7. **T**erminate the protocol



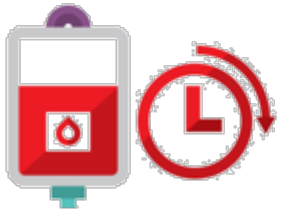
Petrosoniak et al. Emerg Med Clin N Am 2023;41:51-69

Trigger the Protocol

Consider using one or more objective MHP triggers

Critical Administration Threshold

≥3 RBC units in 1 hour



Shock Index†

$$\frac{\text{Heart Rate}}{\text{Systolic BP}} > 1$$

ABC Score‡

≥2 of

- ✓ Penetrating mechanism
- ✓ Systolic BP < 90 mmHg
- ✓ Heart Rate > 120 bpm
- ✓ +FAST ultrasound

RABT Score*

≥2 of

- ✓ Penetrating mechanism
- ✓ Shock Index > 1
- ✓ +FAST ultrasound
- ✓ Pelvic fracture

"Code Transfusion"
Standardized language

Trudeau JD, Dawe P, Shih AW. Massive hemorrhage and emergency transfusion. In: Clarke G, Chargé S, editors. Clinical Guide to Transfusion [Internet]. Ottawa: Canadian Blood Services, 2021. [cited 2024 11 23]. Chapter 11. Available at Professionaleducation.blood.ca

2 Team Preparation

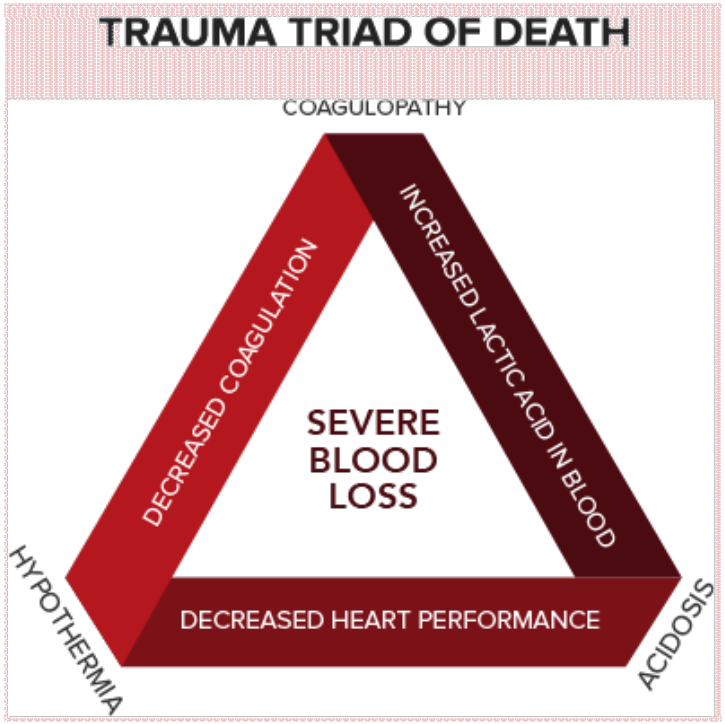
- Organized team approach and identification
  - Code leader
  - Nursing (3)
  - Labs: hematology, chemistry, blood bank
  - Porter
  - (rest of trauma team)

- What happened?
- What has been done?
- What will be needed?

Tranexamic Acid

- Tranexamic acid can improve coagulopathy and there is evidence of survival benefit in some populations
- Tranexamic acid should be given as soon as possible → Target within 1 hour (at least within 3 hours; exception: GI bleed)
- Give 2 g IV bolus
  (or 1g IV bolus + 1g IV over 8 h)

Triad → Diamond



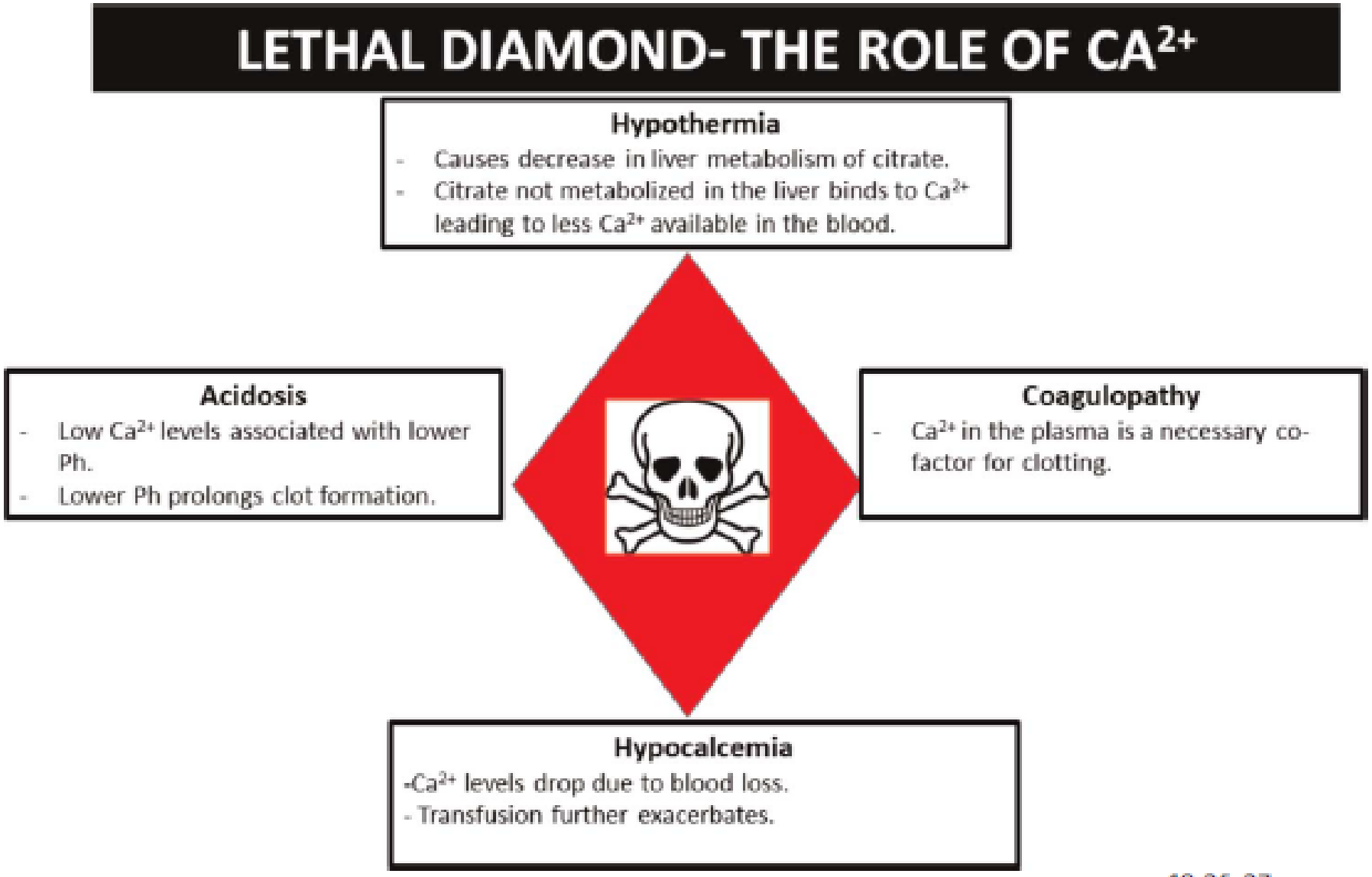


Figure 2. Demonstration of the interaction of calcium with the other aspects of the lethal diamond.[18,25–27]

Calcium…not just for healthy bones

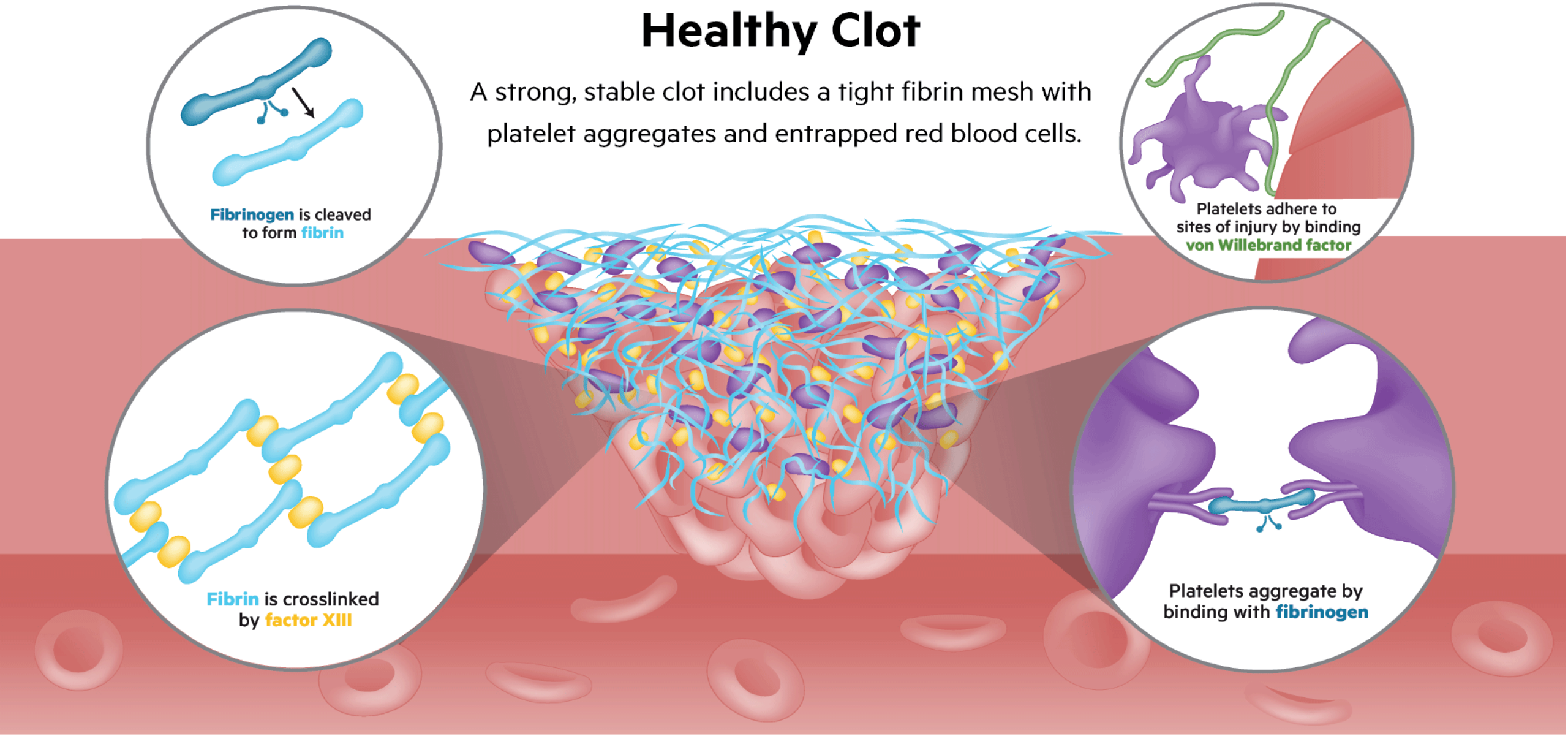
- ~50-55% of trauma patients are hypocalcemic irrespective of requiring blood products or not
- MHPs cause hypocalcemia due to large amounts of citrate

The problem with “Coags”

- “Coag” tests are often associated with PT/INR and aPTT only
- *Neither* tells us if we have the necessary building blocks to form a clot (like hemoglobin level in a CBC)

Healthy Clot

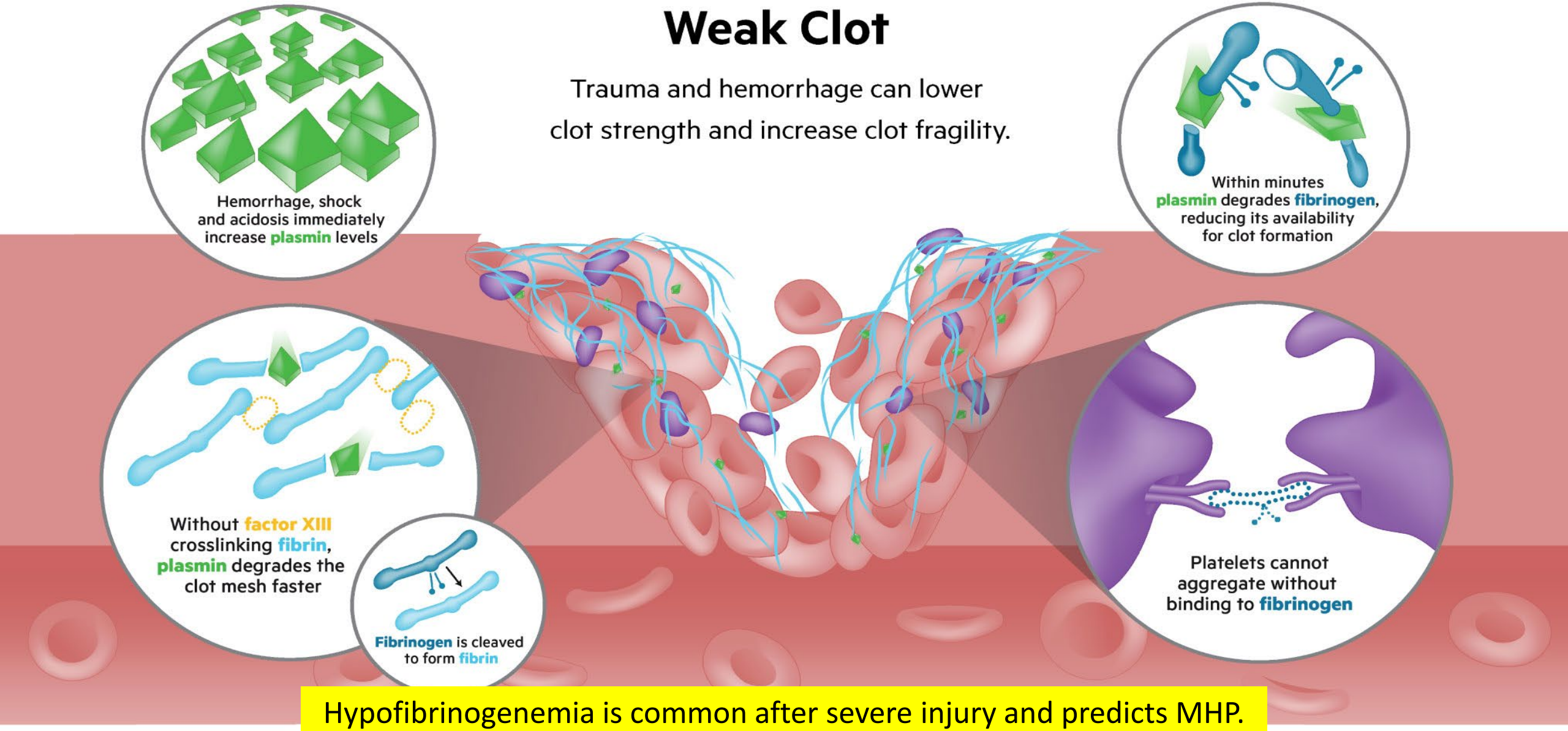
A strong, stable clot includes a tight fibrin mesh with platelet aggregates and entrapped red blood cells.



Fibrinogen, **factor XIII** and **von Willebrand factor** add the clotting strength needed to achieve stable clot formation and restore hemostasis.

Weak Clot

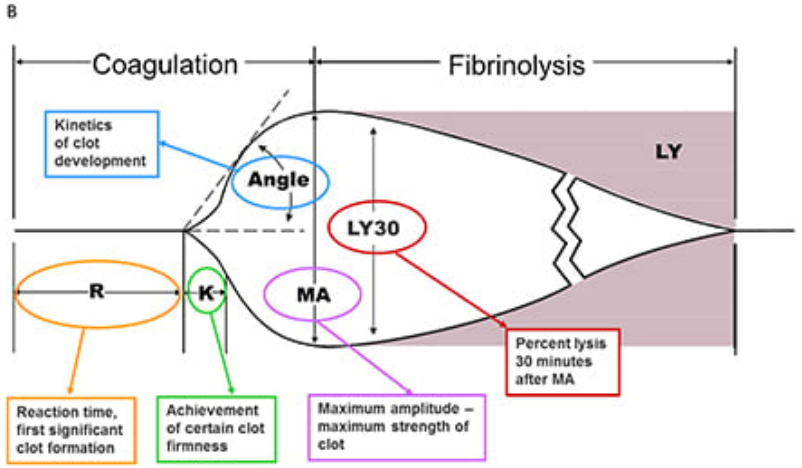
Trauma and hemorrhage can lower clot strength and increase clot fragility.



Hypofibrinogenemia is common after severe injury and predicts MHP.

Without **fibrinogen** binding platelets together and **fibrin** crosslinked by **factor XIII**, platelets are unable to contract the clot.

Fibrinogen



Fibrinogen Concentrate (FC)	4 g over 10 minutes
Prothrombin Complex Concentrate (PCC)	2000 IU over 10 minutes
Tranexamic Acid (TXA)	1 g bolus plus 1 g infusion over 8 hours

Alternatives

1 g bolus and 1 g bolus repeated at 1 hour

1 g bolus and repeated if ongoing bleeding at ≥ 30 minutes

2 g single bolus

Pro-tip: Blue-to-Water

Test hourly

- Group & Screen must be prioritized to mitigate impact on group O RBCs and AB plasma
- Lab testing done at baseline and q1h until code transfusion is stopped
  - CBC, INR, fibrinogen (aPTT at baseline only)
  - Lytes, calcium (ionized), blood gas (pH, base excess), lactate

Transfusion

- Start with immediate RBCs, then 2 RBC:1 plasma ratio
- Emergency uncrossmatched components (O RBCs, AB FP)
  - Aim to switch to group specific ASAP
- Switch to lab guided as soon as results are available

- Targets during MHP:
  - Hb > 80 g/L (RBC)
  - INR < 1.8 (plasma)
  - Fibrinogen > 1.5 g/L (fibrinogen concentrate)
  - Platelets > 50 x 10^9/L (platelets) (80 TBI)
  - Ionized Ca^{2+} > 1.15 mmol/L

Transfusion Packs for Adults with Massive Hemorrhage

BIG HOSPITAL

Pack 1	4 units O negative RBC (women < 45 years) 4 units O positive RBC (all others)
Pack 2	4 units RBC 4 units FP
Pack 3	4 units RBC 2 units FP 4 g FC
Pack 4 and beyond	4 units RBC 2 units FP

GIVE PLATELETS AS NEEDED

Once available, use lab values to guide transfusion

SMALL HOSPITAL
(Do Not Carry Plasma)

Transfer patient to a hospital capable of definitive hemorrhage control

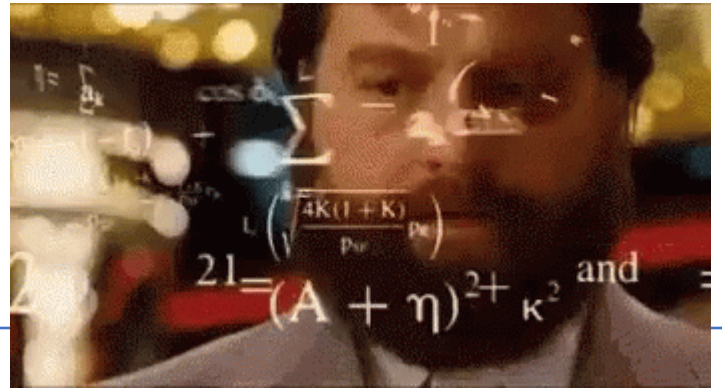
Pack 1	4 units O negative RBC *if in stock* (women < 45 years) 4 units O positive RBC (all others)
Pack 2	4 units RBC 2000 IU PCC 4 g FC

If transfer is not possible...proceed to Pack 3

Pack 3 and beyond	4 units RBC 2000 IU PCC 4 g FC

IF PLATELETS NOT STOCKED, AND PATIENT CANNOT PROMPTLY BE TRANSFERRED OUT, ORDER PLATELETS

Math ain’t mathing…



1 bag = 1 unit

8 bags

1 bag = 1 unit

4 bags

1 bag = 4-6 units

1 bag

2 : 1 : 1

6 Temperature

- Measure at baseline then <u>at least</u> Q30mins during MHP (…poorly done…)
- Target patient's temperature ≥ 36°C
- Why is this important?
  - Often hypothermic (T< 36°C) in the trauma setting
  - 2.7x mortality in first 24hrs
  - Poorly monitored during pre-hospital and pre-OR phase- 60% hypothermic
  - Temp <34°C associated with an increase in mortality
  - Each 1°C increases blood loss by 16% and the risk of transfusion by 22%
  - Pts feel better when they are warmer

Alam A et al. Injury 2018;49:117-123
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UNITED STATES ARMY
READY HEAT
TechTrade

Whole Blood, leukocyte reduced (LrWB): Is the whole is greater than the sum of its parts?

- Approved by Health Canada in October 2022 for patients with clinically significant bleeding
  - Approved by NAC for military use only
- Some logistical advantages compared to component resuscitation
- Collected from Group O male donors with low anti-A/B titres (less than 1:128) (low titre group O whole blood = LTOWB)
- Shelf-life 21 days

	LrWB	RBC	PR PLTs	SDP
Volume	496 mL	287 mL	180 mL	200 mL
Hematocrit	41%	67%	-	-
PLT Count	83 $x10^9$/L	-	251 $x10^9$/L	-

Courtesy Dr. J. Mack, Canadian Blood Services

SWIFT: Study of Whole Blood in Frontline Trauma (Prehospital)

SWIFT
Study of Whole blood in Frontline Trauma
CANADA

- Pilot Feasibility Trial
- Patients: Attended by Ornge with traumatic hemorrhage
- Intervention: 2 units LTOWB (low titre O Whole Blood)
- Control: 2 RBC + 2 Plasma
- Outcome: Composite 24 hour mortality or need for massive transfusion (>10 units in 24 hours post randomization)

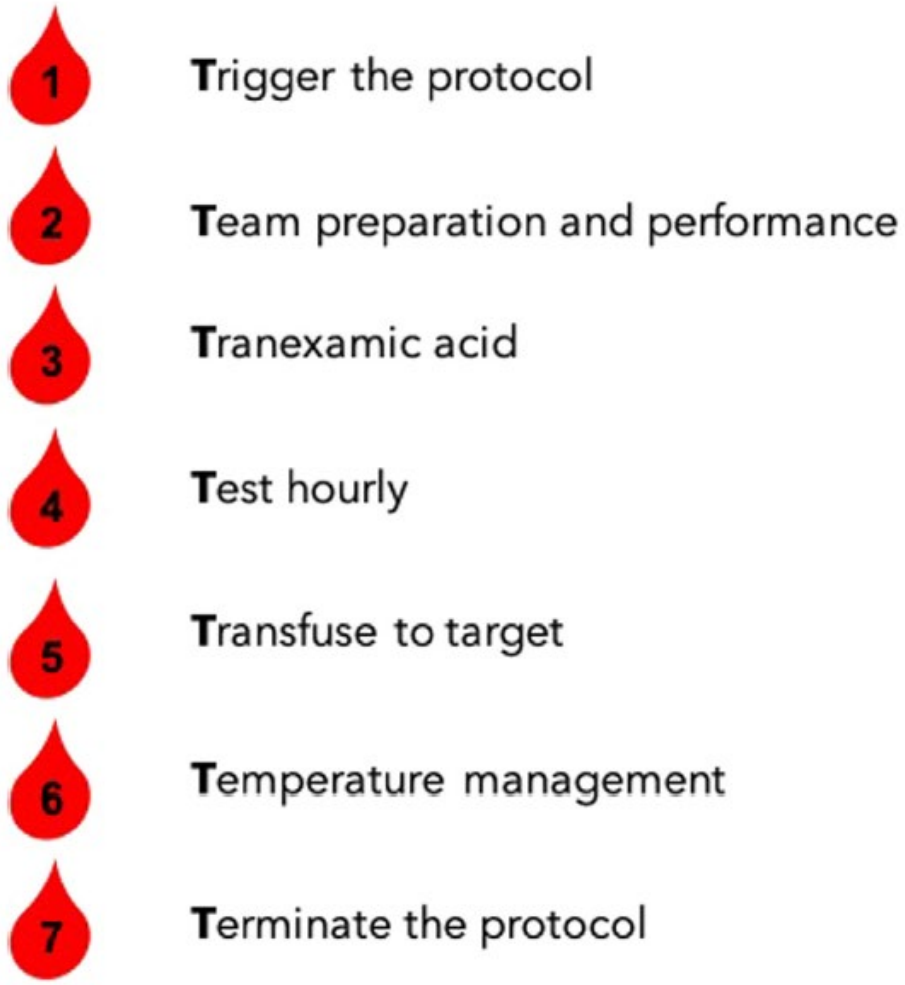
- Sample size: 50 pts
- Opening Winter 2025 at Ornge (Sunnybrook Blood Bank)

UK PI: Laura Green; SWIFT Canada PI: Brodie Nolan

7 Termination

- Once bleeding source control attained and transfusion slowed cancel the MHP
- Consider hot debrief (4S: Staff, Supplies, Space, System)
  - What went well?
  - What can be improved?

MHP Summary



1. Bleeding patients need calcium
2. Watch/replace the fibrinogen
3. Keep patients warm
4. Whole blood is coming

Post-Test Question #1

A patient requiring an MHP has received 7 units of RBC, 3 units plasma. Additional blood products are being prepared. Which of the following would be reasonable to give next?

a) Fibrinogen concentrate 4g
b) Calcium chloride 1g
c) Platelet pool
d) Prothrombin complex concentrate 2000IU

Post-Test Question #2

Which of the following is NOT a reason to promote active warming measures during an MHP?

a) Warming measures are expensive
b) Patient feel better
c) Hypothermia promotes blood loss
d) Trauma patients are usually cold

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Thank you!

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