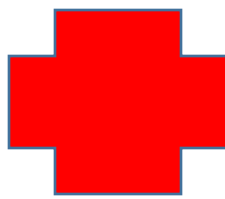


# TRAUMA ALERT



***Welcome to the Trauma Alert Education Newsletter brought to you by  
Beacon Trauma Services.***

***Edition 9 (2021)***

## ***Hemorrhagic Shock and the Trauma Patient***

### **All Bleeding Eventually Stops!**



Source: <https://tinyurl.com/y87tzjmh>

- There are several types of shock that can affect the trauma patient. This edition will focus on hemorrhagic shock.
- The first step in managing shock is to recognize its presence and initiate care and treatment based upon the probable cause.
- Shock is inadequate organ perfusion and tissue oxygenation and this definition can help guide the trauma team in the diagnosis and treatment.
- Hemorrhagic shock is the most common type of shock in trauma patients.
  - Hemorrhage is the acute loss of circulating blood volume.
    - It can vary considerably but the normal adult blood volume is 7% of the body weight. For example, an 80kg male has a circulating blood volume of approximately 5.6 L.
    - To prevent overestimation, the blood volume of an obese adult trauma patient is estimated based on their ideal body weight.
  - No single vital sign or laboratory test on its own can definitively diagnose shock.

- There are several classes of shock based on signs and symptoms and various parameters like: blood loss, heart rate, blood pressure, respiratory rate, urine output, Glasgow coma score, and base deficit.
  - An elevated shock index is an early sign of hemorrhagic shock.
- It is important to initiate treatment and volume replacement when the patient is exhibiting early signs of hemorrhagic shock. Delaying treatment until the patient is in moderate to severe shock can greatly affect the resuscitation outcome.

Signs and Symptoms of Hemorrhage by Class				
Parameter	Class I	Class II (Mild)	Class III (Moderate)	Class IV (Severe)
Approximate blood loss	<15%	15-30%	31-40%	>40%
Heart rate	↔	↔ / ↑	↑	↑ / ↑↑
Blood pressure	↔	↔	↔ / ↓	↓
Pulse pressure	↔	↓	↓	↓
Respiratory rate	↔	↔	↔ / ↑	↑
Urine output	↔	↔	↓	↓↓
GCS score	↔	↔	↓	↓
Base deficit <sup>1</sup>	0 to -2 mEq/L	-2 to -6 mEq/L	-6 to -10 mEq/L	-10 mEq/L or less
Need for blood products	Monitor	Possible	Yes	Massive Transfusion Protocol

<sup>1</sup> A base excess = quantity of base (HCO<sub>3</sub><sup>-</sup>, in mEq/L) that is above / below the normal range in the body. A negative number is called a **base deficit** and indicates metabolic acidosis.

from The Committee on Trauma, American College of Surgeons. ATLS Student Course Manual. 10<sup>th</sup> ed. 2018: 49.

Source: <https://tinyurl.com/y9hptdp2>

- The basic management of hemorrhagic shock is to stop the bleeding and replace the lost volume.
- During the physical examination the focus should be on diagnosing any life threatening injuries and assessing the ABCDEs.
  - Airway and Breathing
    - Establish a patent airway and maintain adequate ventilation and oxygenation.
    - Intervene with basic or advanced airway adjuncts to maintain oxygen saturation levels at 95% or greater. Even one episode of hypoxia can be detrimental to a trauma patient.
  - Circulation: Hemorrhage Control
    - Assess for any uncontrolled hemorrhage and stop the bleeding.
      - Bleeding from external wounds can be controlled with direct pressure, packing, and a tourniquet.
      - A sheet or pelvic binder should be considered early if an unstable pelvic fracture is suspected.
      - One episode of hypotension is detrimental in the trauma patient.

- Obtain adequate intravenous access with two large bore IV's. Refer to the table below on IV catheter sizes and flow rates.

### Go Big or Go Home!

Size(G)	Color Code	Catheter(mm)		Catheter Effective Length (mm)	Flow Rate (ml/min)
		Nominal O.D	O.D (mm)		
<b>14</b>	Orange	1.9 2.0 2.1 2.2	1.85---2.249	45(51) $\pm$ 2	<b>300</b>
<b>16</b>	Grey	1.6 1.7 1.8	1.55---1.849	45(51) $\pm$ 2	<b>195</b>
<b>17</b>	White	1.4 1.5	1.35---1.549	45(51) $\pm$ 2	<b>133</b>
<b>18</b>	Dark Green	1.2 1.3	1.15---1.349	45(32) $\pm$ 2	<b>90</b>
<b>20</b>	Pink	1.0 1.1	0.95---1.149	32(25) $\pm$ 2	<b>50</b>
<b>22</b>	Blue	0.8 0.9	0.75---0.949	25(19) $\pm$ 2	<b>25</b>
<b>24</b>	Yellow	0.7	0.65---0.749	19 $\pm$ 2	<b>20</b>
<b>26</b>	Purple	0.6	0.55---0.649	19 $\pm$ 2	<b>15</b>

Source: <https://tinyurl.com/y84soe28>

- All volume replacement with isotonic crystalloids or blood products should be warmed. Never give a trauma patient cold fluids or blood products.
- The table below is a guide to fluid/blood replacement based on the initial patient response to volume replacement.
- Remember that continued infusion of large volumes of fluid and blood in an attempt to achieve a normal blood pressure is not a substitute for definitive control of bleeding.

Responses to Initial Fluid Resuscitation <sup>1</sup>			
	Rapid Response	Transient Response	Minimal or No Response
<b>Vital signs</b>	Return to normal	Transient improvement, recurrence of decreased blood pressure and increased heart rate	Remain abnormal
<b>Estimated blood loss</b>	Minimal (<15 % )	Moderate and ongoing (15%–40%)	Severe (>40%)
<b>Need for blood</b>	Low	Moderate to high	Immediate
<b>Blood preparation</b>	Type and crossmatch	Type-specific	Emergency blood release
<b>Need for operative intervention</b>	Possibly	Likely	Highly likely
<b>Early presence of surgeon</b>	Yes	Yes	Yes

<sup>1</sup> isotonic crystalloid solution; up to 1L in adults, 20 mL/kg in children

from The Committee on Trauma, American College of Surgeons. ATLS Student Course Manual. 10<sup>th</sup> ed. 2018: 53.

Source: <https://tinyurl.com/ybvfph6>

## Packed red cells



- fastest way to increase the oxygen-delivering capacity of the blood.
- A unit of whole blood or packed red cells will **raise the hematocrit by 3%** and the **hemoglobin by 1-1.5 gm/dL**

Source: <https://tinyurl.com/ybnwcc8m>

## Platelet concentrates

- Platelets must be stored at room temperature, so are good only for 5 days or less.
- One unit will usually raise the platelet count 5-10k/microliter.

Source: <https://tinyurl.com/y9wh9ju4>

## FRESH FROZEN PLASMA



- Contains all Clotting Factors (1 unit/ml)
- Storage
  - Comes in 200ml bags.
- Can be stored upto 12 months at -18 degrees.
- It is a source of vit k- dependent clotting factors and factor - V.
- Indications for Transfusion:
  - Coagulation Factor deficiency, fibrinogen replacement, DIC, liver disease, conditions with raised APTT.
- Considerations
  - Plasma should be recipient RBC ABO compatible
  - Preferably, should also be Rh compatible.
  - Usual dose is 20 cc/kg
  - 1 unit FFP = 3% increase in CF levels

Source: <https://tinyurl.com/y7cqb6us>

## ADULT GOAL-DIRECTED MASSIVE TRANSFUSION PROTOCOL (MTP)

### Determine Need to Activate the MTP (see PALS guideline for pediatric clinical triggers)



- Major traumatic, vascular, obstetric or GI bleeding
- Common clinical triggers (4 or more)

- |                     |                                    |
|---------------------|------------------------------------|
| * HR > 120          | + FAST/+ CT                        |
| * SBP < 90          | *Uncontrollable hemorrhage (blunt) |
| * Base deficit > -6 | *Transpelvic/multi-cavity GSW      |

- Consider if 4 units PRBCs transfused in a short period of time with ongoing bleeding



### Notify Key Personnel

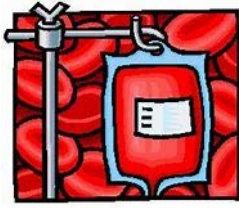
- Initiate by calling Blood Bank
- Also notify OR Charge Nurse



### Prepare

- Draw baseline labs as needed: T&C, CBC, PT/PTT, Fibrinogen/FDP/D-dimer, I-STAT 8+ (Ca++) and Magnesium
- Repeat labs 30 mins after initiation then q 60 mins

- Assure large bore venous lines including central line (sheath)
- Prepare rapid infuser/warmer



Transfuse in following ratios until TEG available (see reverse side for Pediatric dosing):

PACK #	RBC	Plasma	Platelets (not warmed)	Cryo (not warmed)	CaCl (central line)
1	6	6	1	0	1 Gm
2	6	6	0	0	

Further transfusion guided by TEG as soon as available

#### Therapeutic Adjuncts

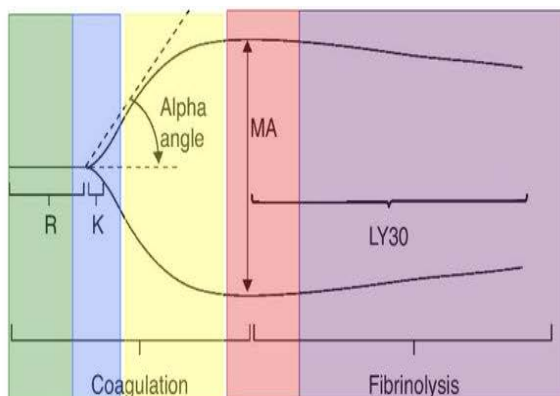
- Prothrombin Complex Concentrate (PCC, Kcentra) – Dose 25-50u/kg based on initial INR. Infuse over 20 minutes. Dose not repeated.
- Tranexemic acid (TXA) – Dose 1 gm IV over 10 minutes. Followed by 1 gm over 8 hours. Should be given within 3 hours of injury.
- Consider Factor VIIa early if pH > 7.20. Dose 90 mcg/kg IV.
- Consider administering calcium chloride.



- Citrate is the anticoagulant in blood products and it binds to the calcium in the blood resulting in hypocalcemia.
- Calcium should only be administered at the direction of the physician and based on lab results.
  - An ionized calcium level is drawn instead of a regular calcium level.
- After the first 4 units of RBCs have been transfused the administration of CaCl (1 gram in 50 ml diluent) IVPB over 10 minutes should be considered.
  - Place in separate line in a large vessel preferably a central line.
  - Calcium is a potent vesicant that causes necrosis and sloughing if it infiltrates.

Source: <https://tinyurl.com/y8b3btce>





# REBEL REVIEWS

Thromboelastogram (TEG)				
Components	Definition	Normal Values	Problem with...	Treatment
R Time	Time to start forming clot	5 - 10 minutes	Coagulation Factors	FFP
K Time	Time until clot reaches a fixed strength	1 - 3 minutes	Fibrinogen	Cryoprecipitate
Alpha angle	Speed of fibrin accumulation	53 - 72 degrees	Fibrinogen	Cryoprecipitate
Maximum Amplitude (MA)	Highest vertical amplitude of the TEG	50 - 70 mm	Platelets	Platelets and/or DDAVP
Lysis at 30 Minutes (LY30)	Percentage of amplitude reduction 30 minutes after maximum amplitude	0 - 8%	Excess Fibrinolysis	Tranexemic Acid and/or Aminocaproic Acid

Source: <https://tinyurl.com/y8d7mueq>

- One way to monitor and alter what blood products are given is to utilize a (thrombelastography) TEG curve. A whole blood sample is placed into the TEG analysis machine where it is analyzed from the start of clotting, how the clot is formed, clot stability, and finally the clot breakdown.
- It provides valuable information that can be used to better determine the blood product replacement for each trauma patient.
- Thromboelastography (TEG) may be used to screen patients for coagulopathy in the following situations:
  - Blunt or penetrating trauma patients who arrive in hemorrhagic shock.
  - Patients receiving massive transfusion protocol (MTP) to evaluate for guided product therapy.
  - Clinical suspicion for hemorrhage or coagulopathy.
  - Patients needing multiple blood transfusion and/or receiving MTP should have a TEG drawn.
  - **TEGs SHOULD BE REPEATED AFTER 30 MINUTES AFTER ANY INTERVENTATION UNTIL NORMALIZATION.**
  - 24 hour TEG post transfusion and stabilization should be highly considered.
- Procedure at Memorial
  - Lab tech will be present for all 911/912 activations.
  - 911 activations will have a TEG drawn automatically.

- 912 activations will need to have an order for TEG and the lab tech notified.
- Platelet mapping order will need to be placed and lab notified.
- Blood should be obtained in a 3.2% citrate blue top for the **Trauma cartridge**. The specimen should be good for up to 2 hours.
- Blood should be obtained with sodium or lithium green top heparin tube, only non-gel heparin Vacutainer for the **Platelet mapping**.
- Disability: Neurological Examination
  - This will help to determine the patient's level of consciousness, which is useful in assessing cerebral perfusion.
  - Inadequate perfusion from hemorrhagic shock can cause signs of CNS dysfunction.
- Exposure
  - Undress the patient and assess for any obvious external hemorrhage or life threatening injuries needing immediate intervention.
  - It is essential to prevent hypothermia and keep the patient warm when exposing and examining the patient.
  - Utilize fluid warmers and external passive and active warming techniques such as: warm blankets, warmed oxygen, and Bair Hugger™ devices.

## Pediatric Corner

### Massive Transfusion Protocol for Pediatric Patient

#### Pediatric Dosing Parameters

#### Pediatric Blood Dosing Parameters

Age	Estimated blood volume	Product	MTP Pack 1	MTP Pack 2	MTP Pack 3	MTP Pack 4(1)
Premature infant	90-100 ml/kg	<b>PRBC</b>	25ml/kg	20ml/kg	20ml/kg	20ml/kg
Term infant to 3 months	80-90 ml/kg	<b>FFP</b>	20ml/kg	20ml/kg	20ml/kg	20ml/kg
Children older than 3 months	70 ml/kg	<b>PLT</b>	10ml/kg	10ml/kg	10ml/kg	10ml/kg
Obese Children	65ml/kg	<b>Cryo.</b>	4ml/kg	4ml/kg (2)	4ml/kg (2)	4ml/kg (2)

**Children <10 kg: Blood products are to be physician order specific for any child <50kg.**



Source: <https://tinyurl.com/yag4y9gk>

1. The early recognition of shock in the trauma patient is based upon which of the following?
  - a. Pre-existing history and mechanism of injury.
  - b. Abnormal laboratory values.
  - c. Signs of diminished tissue perfusion and oxygenation.
  - d. Signs of decreased blood pressure and hemodynamic values.
2. Which of the following is an early indicator of hemorrhagic shock?
  - a. Widened pulse pressure.
  - b. Elevated shock index.
  - c. Hypothermia.
  - d. Apnea.
3. Which of the following are true about a TEG test?
  - a. It is used to determine how much IV fluid to administer.
  - b. It is used to determine how much and what type of blood products to administer.
  - c. It can be drawn in any lab tube.
  - d. It is drawn on patients when one unit of blood is administered.

**Answers at the end**

#### Recognition/Thank You

- Peri-Anesthesia week- February 1-7.
- Cardiovascular professional's week- February 14-20.
- Critical care transport day-February 18.
- National wear red day- February 5.
- National donor day February 14.
- Valentine's day- February 14.
- American heart month





Source: <https://tinyurl.com/ych7kg5b>

### **Test your knowledge Answers-**

1. C      2. B      3. B

### **References**

Advanced Trauma Life Support Student Manual, 10<sup>th</sup> ed., (2018). Chicago. American College of Surgeons.

### **Guidelines**

1. TRAUMA GUIDELINE: Thromboelastography (TEG) in Trauma Patients
2. Adult Goal-Directed Massive Transfusion Protocol
3. ECC Self-study packet on massive transfusion protocol

***For questions or future submissions contact Stacie Bobeck MSN, RN, CEN, CPEN, TCRN, SANE-A  
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