Bleeding Control, Management, Replacement

UCLA Paramedic Transition Course 2013
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Loss of circulating blood volume from hemorrhage is the most common cause of shock in trauma patients.

As stated elsewhere today...

Approx ½ of all trauma deaths occur from CNS injury.

Approx 1/3 of all trauma deaths occur from exsanguinations.

Significant drops in BP are generally not manifested until up to 30% of a patient’s blood volume is lost!
As a result of hemorrhage in the body...

The body responds with a compensatory stimulation of the sympathetic nervous system to maintain oxygen delivery to the tissues.

You develop...

Increased ventricular contractility...

Leading to increased HR and SV...

Increased RR...

Vasoconstriction...
As the shock state progresses...

Vital organ perfusion (heart & Brain) can only be maintained at the expense of non-vital organs.

If shock not reversed...

Progressive lactate production leads to worsening systemic metabolic acidosis...

Which along with hypoxemia ....

Ultimately leads to loss of peripheral vasoconstriction & cardiovascular collapse
Sympathetic VS. Parasympathetic Nervous System Action

- **SNS (excitatory)**
  - **Increased**
    - cerebral perfusion
  - **Increased**
    - heart rate
  - **Increased**
    - blood flow to skeletal muscles
  - **Decreased** digestion
  - Pupils dilate
  - Bronchial dilation

- **PSNS (inhibitory)**
  - **Decreased**
    - cerebral perfusion
  - **Decreased**
    - heart rate
  - **Decreased**
    - blood flow to skeletal muscles
  - **Increased** digestion
  - Pupils constrict
  - Bronchial constriction
Important signs of evolving hemorrhage

- Tachycardia
- Hypotension
- Cool extremities
- Weak peripheral pulses
- Prolonged Cap refill (> 2 secs)
- Narrowing pulse pressure (< 25 mmhg)
- AMS w/o head injury

- Traumatic shock from hemorrhage most commonly comes from blunt intraabdominal injury
What Blood loss looks like

Classes of Hemorrhage based on clinical presentation

- **Class I: (up to 15%)**
  - HR = normal or minimally elevated
  - BP = normal
  - Pulse pressure = normal
  - Respiratory rate = normal

- **Pulse pressure = SBP – DBP**
  - If your BP = 120/80….your PP = 40
  - If your BP = 70/40….your PP = 30
Pulse Pressure

- A pulse pressure is considered abnormally low if it is less than 25% of the systolic value.
- The most common cause of a low (narrow) pulse pressure is a drop in left ventricular stroke volume.
- In trauma ...
- a low or narrow pulse pressure suggests significant blood loss
- (insufficient preload leading to reduced cardiac output).
Moderate Bleeding

Class II: (15 to 30%)

- Tachycardia (100 – 120/min)
- Tachypnea (20 -24/min)
- Decreased Pulse pressure
- Minimal SBP drop if at all
  - (primary HR compensation occurs)
- Skin signs evident
  - cool, clammy, delayed cap refill
Severe Bleeding...!

Class III: (30-40% loss)

- BP drops significantly
  - (any BP less than 90!)
  - (BP drops 20 -30% from initial measure!)
- Changes in Mental Status
  - Disorientation, Poor STM, can’t focus attention
  - Agitation, Anxiety
- HR > 120/min
- Mod Tachypnea
- Delayed Cap refill
Critical Hemorrhage...!

Class IV: ( > 40% loss)

- Significant BP loss
- + AMS
- Pulse Pressure narrows (< 25 mmhg)
- Cold, Pale skin with delayed cap refill
- No urine being produced
- Absent peripheral pulses
How Much Blood Do We Have...?

- Average Human blood volume = 70 – 90 ml/kg
- Therefore...
- If you weigh 180 lbs...
  - You have 80ml x 81.8kg = 6.54 L
  - (30% loss = 1.9L)

- If you weigh 65 lbs (my 6 y/o)
  - You have 90ml x 29.5kg = 2.65 L
  - (30% loss = 750ml)
  - Little over 3 cups to lose...
Where do Trauma pts bleed...

Large scale bleeding occurs at 5 possible locations

1. Major external wounds
   - Thigh can hold one to two L of blood

2. Chest (thoracic cavity)
   - Cardiac Tamponade, Tension Pneumothorax

3. Abdomen (peritoneal cavity)

4. Retroperitoneum (from Pelvic Fx)
   - Pelvic cavity can hold 50% blood volume

5. Scalp & Face wounds can bleed profusely & are overlooked, possibly under-appreciated
Control Bleeding...ACT!

- Direct Pressure with Bulky Padding and Elastic Bandage (wet better)
- Apply Cloth Circumferential Peritoneal Binder
- Tourniquets ("two-two-two")
  - 2 " proximal of amputated or mangled extremity
  - 2" is minimal for width of constricting band
  - 2 hours is the longest it should be in place (some literature says release after 45 min)
- Establish 2 large bore IV’s (#14, #16, #18)
- Infuse 0.9 NS or LR for 2L as fast as possible.
- Begin massive transfusion protocol for ongoing bleeding
  - PRBC, FFP, Platelets @ a ratio of ...1:1:1
  - Avoids Hemo-dilution & Coagulopathy
  - Avoid Hypothermia during resuscitation
Debate continues over best fluid for resuscitation of hypovolemic shock

- LR or NS?
- Large volumes of 0.9NS can lead to Hyper-chloremic metabolic acidosis
- Large volumes of LR can lead to Metabolic Alkalosis
- Large volumes of isotonic crystalloids will lead hemo-dilution, coagulopathy and hypothermia
- My research found favor for 0.9NS for up to 50ml/kg then switch to LR for patients requiring additional IV fluids
  - *www.Uptodate.com 2013: Initial evaluation and management of shock in Adult trauma*
Endpoints for IV fluid bolus wide open

- Clear endpoints remain undefined.
- Always evaluate pt response to initial fluids and overall condition
- MAP $\geq 65$ mmhg or
- A SBP $\geq 90$ mmhg
- Is a reasonable goal with penetrating trauma
- For TBI ...
- MAP $> 105$ or...
- SBP $> 120$ mmhg is reasonable
• The goals are..
  1. Limit ongoing blood loss
  2. Restore intravascular volume
  3. Maintain adequate oxygen delivery

• Direct Pressure
• IV Fluids
• High flow O₂
FAST SCAN

- Focused Assessment with Sonography for Trauma
- Is Ultrasound
- is an integral diagnostic tool used early on in ED trauma care.

- Looks for...
- Hemo-peritoneum (pericardial effusion)
- Intra-abdominal bleeding (peritoneal blood)
The human clotting process is dynamic, highly interwoven array of multiple processes.

Important point

At any given moment the body, in effort to maintain homeostasis, is ready to drop the clot cascade into hemostasis and...

At the same moment, is ready to mobilize anti-clot sequences to prohibit an unnecessary clot, say in the calf of coronary artery!
Blood Clotting made simple...?

Clotting process or ... Tampa Bay Offense..?

Roman numerals indicate Protein mediators

The Clotting Cascade

Intrinsic Pathway (I.P)
- XII → XI → IX → VIII → VII → X → II
- V → Factor XIII
- Fibrinogen (I)
- Fibrin

Extrinsic Pathway (E.P)
- VII → IX → VIII → IXa → X → II
- Fibrinogen (I)
- Fibrin

PTT: measures I.P
PT/INR: measures E.P

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Four Important Phases

I. Initiation and formation of platelet plug
   - (Platelet aggregation after activation)

II. Propagation of the clot by the coagulation cascade

III. Termination of clot by anti-thrombotic control mechanism
   - (anti-thrombin)

IV. Removal of the clot by fibrinolysis*
When the process works correctly...

- When the processes of **clot formation and clot lysis** are appropriately linked...
- A clot is laid down to initially stop bleeding...
- Followed later by clot lysis and tissue remodeling.

- Diminished clot generation (ASA, Coumadin)
- or enhanced clot lysis (Tpa)
- **Can lead to abnormal bleeding**...
- **While excessive clot formation**
- or **reduced clot lysis**
- **can lead to excessive thrombosis** (ACS, PE, DVT)
Novel hemostatic approaches

- Hemostatic agents
- Chitosan dressing
- Quickclot powder
- Fibrin sealant dressing
- All products used by military in combat
- Few controlled studies with civilians
- Unclear how to be used by civilian EMS
Tranexamic Acid

- Anti-fibrinolytic agent that may be of benefit in controlling bleeding following trauma
- Came out of CRASH-2 study
- Involved 274 hospitals in 40 countries, over 20,000 patients
- Overall mortality was lower
- Death from hemorrhage was lower
- No difference in complications were noted (PE, DVT)
- When given within 1-3 hours
- Increased mortality given after 3 hours
- A follow-up study confirmed benefit
- Limited study in USA
- Best place to administer may be the pre-hospital setting!
Blood Factor VIIa

- Off label use widespread in military for injured soldiers with severe hemorrhage
Questions....?