

Shock Talk



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Jon Politis

- Colonie, NY (Albany)
- EMS Chief
- Paramedic since 1980
- EMT since 1971
- Ski patroller since 1968
- Active on EMS unit since 1971
- EMS "life-er"





Auto vs. pedestrian



- Unconscious
- No pulses
- Rapid field BLS/ALS
- PASG/IV fluid
- Pulses return
- What happened ?

Shock

Kid walks into the aid room...



- Feels sick
- Abdomen tender
- Tachycardic
- Wants to leave

Shock

The goal...

- Help you understand how the body compensates for blood loss
- Learn how to recognize shock early



Shock

ABCs !

- Bleeding is a HIGH priority

- External ?

- Stop it ASAP

- Internal

- How do you know they have it ?
 - How can you stop it ?



Shock

Shock: it's the body's effort
to
compensate...



Shock

Cells need...

Oxygen

Glucose



CO₂ + energy



Shock

The organism

- Cells
- Tissues
- Organs
- Organ systems



Shock

The fluid distributing system

- Pump – Heart
- Pipes – Blood vessels
- Fluid – Blood



Shock

The Heart

- Right heart
 - Low pressure
 - 30–40 mm/hg
- Left heart
 - High pressure
 - 120 mm/hg



Shock

The pipes

- Arteries
 - Resistance system
 - 20% blood volume
- Capillaries
 - Exchange
 - 5% blood volume
- Veins
 - Capacitance system
 - 75% blood volume



Blood

- 6-8% of body weight
- +/- 6 liters
- Big people have more blood than little ones



Now some details...



Cardiac output



- $CO = \text{heart rate} \times \text{stroke volume}$
 - $HR\ 70 \times SV\ 70 =$
 $CO\ of\ 4900\ cc/min$
 - $HR\ 100 \times SV\ 70 =$
 $CO\ of\ 7000\ cc/min$

Shock

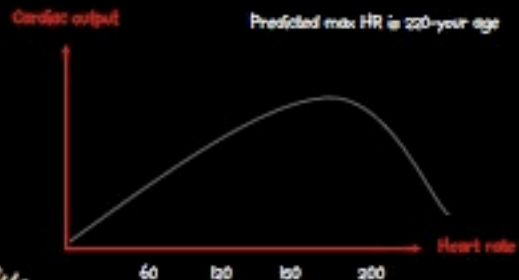
Frank Starling Effect



- The more it stretches the more efficient as a PUMP it becomes... to a point
 - Aerobically fit athlete
 - $HR\ 49 \times SV\ 100 =$
 $CO\ 4900$
 - Normal
 - $HR\ 70 \times SV\ 70 =$
 $CO\ 4900$

Shock

Pump efficiency



Shock

Arteries-Arterioles



- Multi-layered
- Muscular
- Can constrict/dilate
 - Arterioles have greatest impact on arterial resistance



Shock

Resistance...the force



Normal



Constricted



Dilated

- Resistance is the overall measure of constriction the heart must pump against



Shock

Resistance...the force



Normal



Constricted



Dilated

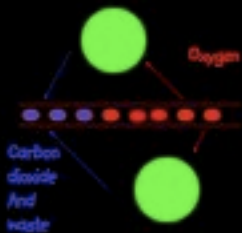


Question :
What happens to a leak when you put your
finger in the end of the garden hose ?



Shock

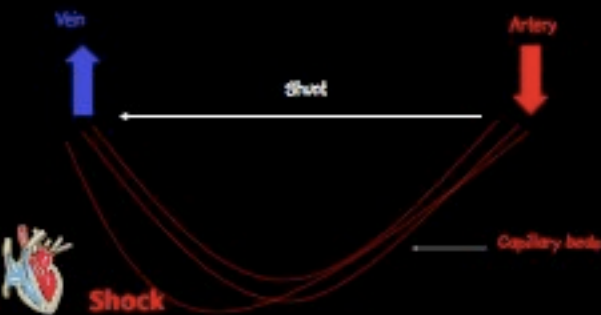
Capillaries



- Single cell thick
- Where oxygen carbon dioxide transfer takes place
- Pre and post capillary sphincters act as valves

Shock

Capillary shunts



Shock

Venous capacity

- +/- 75% of blood volume
 - Virtually no pressure
 - Minimal ability to constrict
 - Much thinner, not as muscular



Shock

Venous return ?



- Muscular action
- Valves
- Respiration



Shock

The 60 second circuit



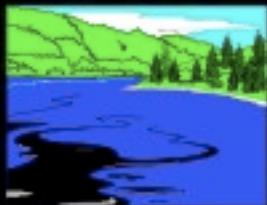
- Left heart
- Arteries/arterioles
- Capillaries
- Veins
- Right heart
- Lungs
- Left heart

What about blood flow during CPR ?



Shock

Homeostasis...



- Body wants to keep things normal
- Many compensatory mechanisms
- Shock response is one of many compensatory mechanisms



Shock

Goal of shock response...



- Maintain blood pressure and flow to vital organs



Shock

Blood pressure



- Cardiac output $\times$ Resistance $\times$ blood volume



Shock

Blood pressure... a fall in volume



Blood Volume $\times$ Cardiac Output $\times$ Resistance

↓ $\times 2$ ↑ $\times 1$ ↑ $\times 1$

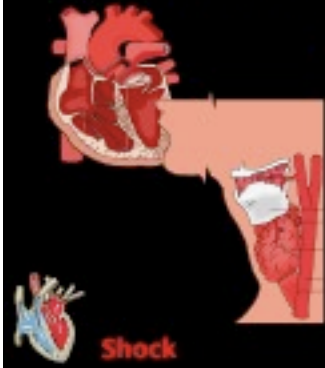
Result ... BP is maintained !



Shock

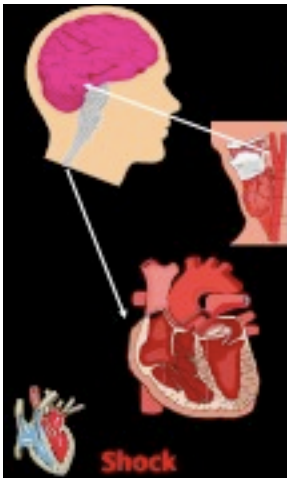
Pressure monitoring...

- Baroreceptors
 - Aortic arch
 - Carotid sinus



Blood loss !

- Baroreceptors sense drop in pressure
- Signal to brain of low pressure
- Sympathetic ANS stimulated
- Epinephrine/ Norepinephrine secreted
- Increased heart rate, force and vasoconstriction
- BP IS MAINTAINED !



Compensated shock

- Increased heart rate
- Vasoconstriction
 - Pallor
 - Clammy
- May complain of thirst
- Look for elevated diastolic BP



Grades of hemorrhage

- Grade 1
- Up to 15% blood loss
- Early compensation
- Slight vasoconstriction and HR increase
- Grade 2
- 15–25% blood loss
- Obvious compensation
- Thirst–Pallor–Restless–Tachycardia



Shock

Grades of hemorrhage

- Grade 3
- 25–35% blood loss
- Falling BP
- Anxiety–Obvious tachycardia–Restlessness – Air Hunger
- Grade 4
- > 35% blood loss
- Appears moribund
- Pulses and BP may not be palpable



Shock

What does this mean ?

- 150% lb person
 - 9–12 pints of blood
- Grades of Hemorrhage
 - 1 = 1.35 to 1.8 pints
 - 2 = 1.8 to 3 pints
 - 3 = 3 to 4.2 pints
 - 4 = 4.2 or >



Shock

How much can you lose ?

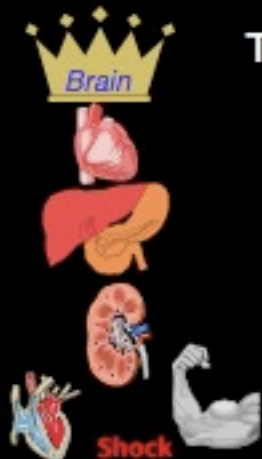
- Chest – total vol
- Abdomen – total vol
- Pelvis – 4–5 pints
- Femur – 2 pints
- Leg – 1 pint



Shock

The pecking order

- Blood is shunted from key places in the following order:
 - Skin and muscles
 - Kidney
 - Gut
 - Heart
 - Brain : is king !



Shock

Compensated shock

- Body compensates
- Increased HR
- Blood shunted from skin and muscles
- Pale–sweaty–thirsty
- BP is maintained



Shock

As shock progresses...



- Pecking order shunts blood
- Heart rate climbs
- BP drops when blood loss continues and body can't compensate



Shock

Decompensated shock



- BP now starts to fall
- Pecking order progresses



Shock

Blood pressure...



- A falling BP is a late indication of bleeding and shock !
- Look for the early signs of increased HR and vasoconstriction !



Shock

Compensated Shock

- Increasing pulse
- Pale cool skin →
- Clammy, sweating
- Sympathetic ANS >
- Vasoconstriction
- Fight-flight response

Remember the skin and muscles get shunted first !



Shock

Decompensated shock

- BP falls
- Thirst →
- Restless/anxiety
- Nausea
- Compensation not enough
- < Vol stimulates brain
- Brain senses hypoxia
- Gut's position in pecking order



Shock

Shock vs acute stress reaction



- Shock: sustained elevated pulse...
- ASR: the heart rate comes down after the epi wears off...
- Remember ! Serial vital signs !



Shock

Shock Mechanisms



Blood Volume $\times$ Cardiac Output $\times$ Resistance
Volume loss Pump failure Vasoilation



Shock

Cardiogenic shock



Blood Volume $\times$ Cardiac Output $\times$ Resistance



Pump failure

Compensation ?



Shock

Hypovolemic shock



Blood Volume $\times$ Cardiac Output $\times$ Resistance



Low blood or
fluid volume

Compensation ?



Shock

Neurogenic shock



Blood Volume $\times$ Cardiac Output $\times$ Resistance

Does head injury cause neurogenic shock?



Vasodilation



Shock

Low resistance

- "Spinal" shock
- Same fluid volume
- Bigger tank

12 pts

12 pts



Shock

Spinal or neurogenic shock

- Brain can't get signal down to cause a sympathetic response
- $<$ BP
- Pulse normal



Shock

Anaphylactic shock



Blood Volume $\times$ Resistance $\times$ Cardiac Output



Role of capillaries?
Role of resistance?
Common causes?



Shock

MVC Serious entrapment...

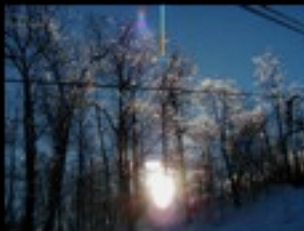
- 22 y/o Serious leg and pelvis injuries
- VS taken within 5 min of MVC
- Vitals
 - 5 min: SP- 110/90, P- 150
 - 10 min: SP- 110/90, P- 150
- What grade hemorrhage?
- How much time does she have?



Shock

Skier vs Tree

- Pain in Inspiration
- Sustained tachycardia
- Times
 - Response 10 min
 - Scene 20 min
 - Aid Room 20 min
 - Ambulance 45 min
 - Transport 30 min



Shock

Cushings Triad

- Rising BP
- Slowing Pulse
- Increased rate and depth of breathing
- The opposite picture of shock !



Shock

GSW to chest...

- 10 min to VS
- BP-70 palp
- Pulse-160
- What grade hemorrhage
- How much time ?



Shock

Initial care...

- Stop the bleeding
 - Recognition
 - Pressure
 - Appropriate splinting
- Oxygen
- Position



Shock

Advanced care...

- Bright lights and cold steel
- Volume support



Shock

Remember...

- Sustained elevated pulse in a trauma patient = bleeding till proven otherwise !



Shock

Questions ?

