THE BASICS OF BLOOD ADMINISTRATION

OBJECTIVES

- BLOOD PRODUCT BASICS
- PATIENT SELECTION
- DO'S AND DON'TS
- PATIENT MONITORING
- REACTIONS
- PRACTICE CASES
- OTHER TRAUMA PEARLS
- HANDS-ON
- QUIZ
- REVIEW

DAMAGE CONTROL

- HEMORRHAGE ACCOUNTS FOR 40% OF TRAUMA MORTALITY
- UP TO 56% OF THOSE DEATHS OCCUR PREHOSPITALLY
- ***MOST COMMON CAUSE OF PREVENTABLE DEATH AFTER THE INITIAL TRAUMA***

BLOOD BASICS

- VOLUME IN ADULTS 5-6 L
- PEDS-80ML/KG

HEMORRHAGE CLASSIFICATION

Table 30-2 Estimated Fluid and Blood Loss for a 154-lb (70-kg) Patient

	Class I	Class II	Class III	Class IV
Blood loss (mL)	<750	750–1,500	1,500–2,000	>2,000
% Blood loss	<15	15–30	30–40	>40
Heart rate (beats/min)	Minimally elevated or normal	100–120	≥120, thready	Marked tachycardia
Systolic blood pressure	Within normal limits	Minimal or no change	Significant drop	Significant depression
Pulse pressure	Within normal limits	Narrow	Narrow	Very narrow
Capillary refill	Within normal limits	May be delayed	Delayed	Delayed
Respiratory rate (breaths/min)	14–20	20–24	Markedly elevated	Markedly elevated
Central nervous system/ mental status	Slightly anxious	Mildly anxious	Anxious and confused	Confused and lethargic
Skin condition	Cool, pink	Cool, moist	Cold, pale, moist	Cold, pale
Urine output (mL/h)	>30	20–30	Diminished	Minimal or none
Fluid replacement	Crystalloid	Crystalloid	Crystalloid and blood	Crystalloid and blood

Normal Circulation	Compensated shock	Decompensated / Hypotensive shock
Clear consciousness	Clear consciousness – shock can be missed if you do not touch the patient	Change of mental state – restless, combative or lethargy
Brisk capillary refill time (<2 sec)	Prolonged capillary refill time (>2 sec)	Mottled skin, very prolonged capillary refill time
Warm and pink extremities	Cool extremities	Cold, clammy extremities
Good volume peripheral pulses	Weak & thready peripheral pulses	Feeble or absent peripheral pulses
Normal heart rate for age	Tachycardia	Severe tachycardia with bradycardia in late shock
Normal blood pressure for age	Normal systolic pressure with raised diastolic pressure Postural hypotension	Hypotension/unrecordable BP
Normal pulse pressure for age	Narrowing pulse pressure	Narrowed pulse pressure (<20 mmHg)
Normal respiratory rate for age	Tachypnoea	Metabolic acidosis/ hyperpnoea/ Kussmaul's breathing
Normal urine output	Reduced urine output	Oliguria or anuria

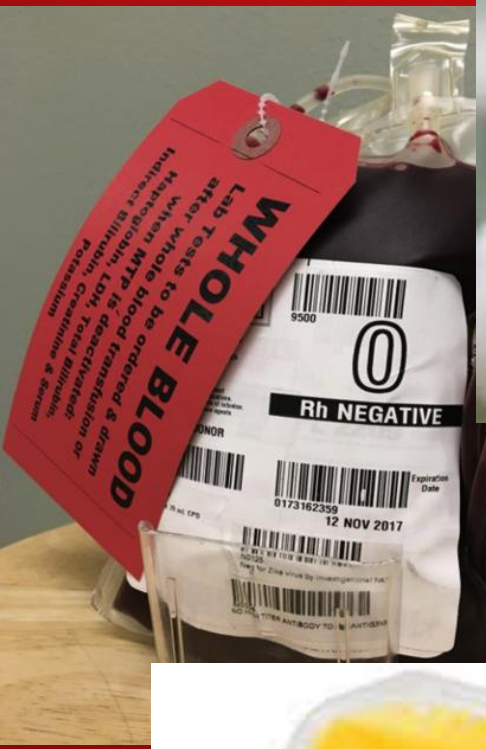
HEMORRHAGIC SHOCK

- BLOOD LOSS
- HEMODYNAMIC INSTABILITY
- DECREASED 02 DELIVERY
- DECREASED TISSUE PERFUSION
- COAGULOPATHY
- CELLULAR DEATH

- BLOOD PRODUCT AVAILABILITY HELPS TO RESTORE CELLULAR PERFUSION, IMPROVE HEMODYNAMIC STABILITY, AND **AFFORD TIME TO SURGICAL INTERVENTION**

BLOOD COMPONENTS

- RED CELLS
- PLASMA
- PLATELETS
- CRYO
- WHITE CELLS



COLLECTED AND COMBINED WITH AN ANTICOAGULANT CALLED CITRATE

WHOLE BLOOD STORED AT 1-6 C

INDIVIDUALIZED PRODUCT STORED AT VARYING TEMPS

WHOLE BLOOD VS. BALANCED RESUS

TYPICALLY GIVEN AS INDIVIDUALIZED PRODUCT: PRBCS, FFP, PLT, CRYO

TREND TOWARDS WHOLE BLOOD ADMIN IN TRAUMA

INDIVIDUALIZED PRODUCT

- TARGETED RESUSCITATION (NO VOLUME OVERLOAD)
- STORED AT APPROPRIATELY INDIVIDUALIZED TEMPS
- PLATELETS MORE EFFECTIVE
- BASED ON INDIVIDUAL LAB VALUES
- LESS WASTE
- LESS ACIDIC, LESS SODIUM/POTASSIUM/AMMONIA
- EASIER ON PTS WITH RENAL, CARDIOVASCULAR OR HEPATIC ALTERATION

WHOLE BLOOD

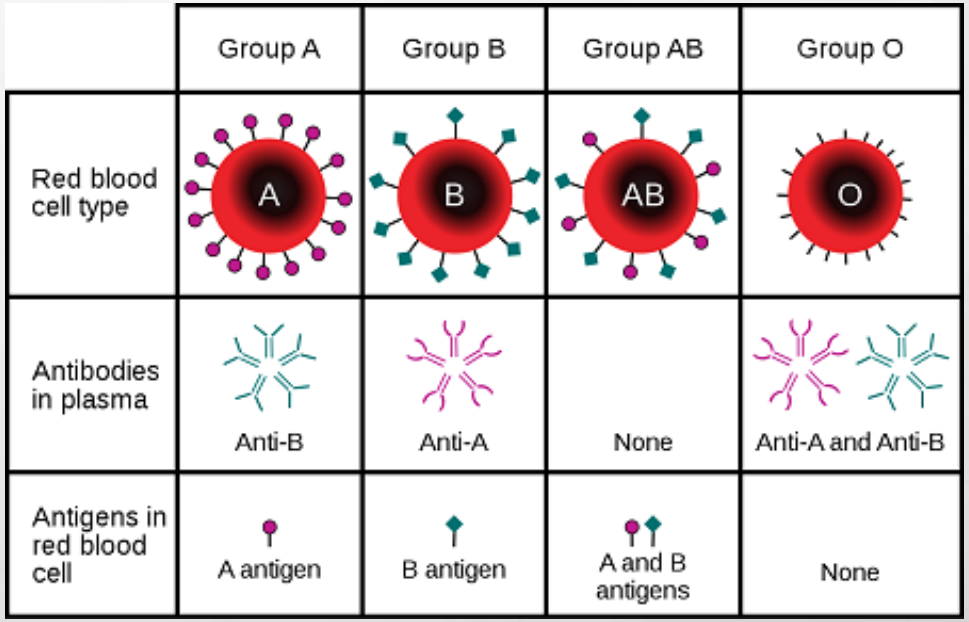
- EASE OF ADMIN
- PLASMA AND RBCS TOGETHER
- SOME CLOTTING FACTORS
- POTENTIAL FOR TACO

BLOOD COMPATIBILITY

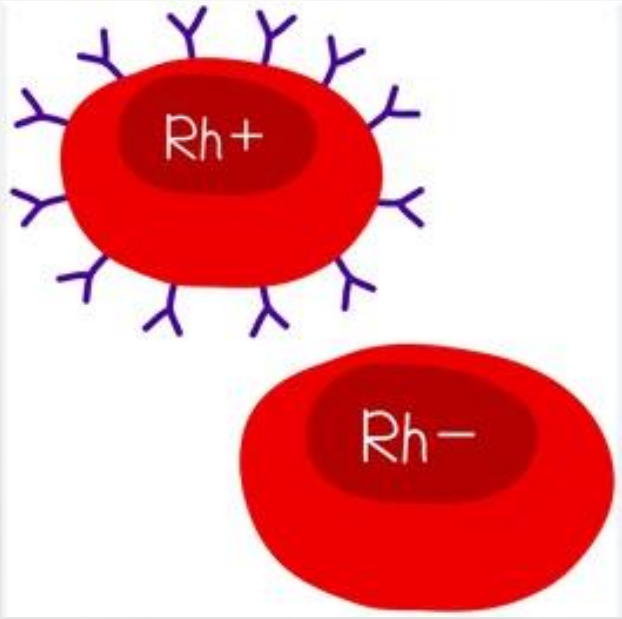
MEDICALNEWSTODAY

Blood Type Compatibility

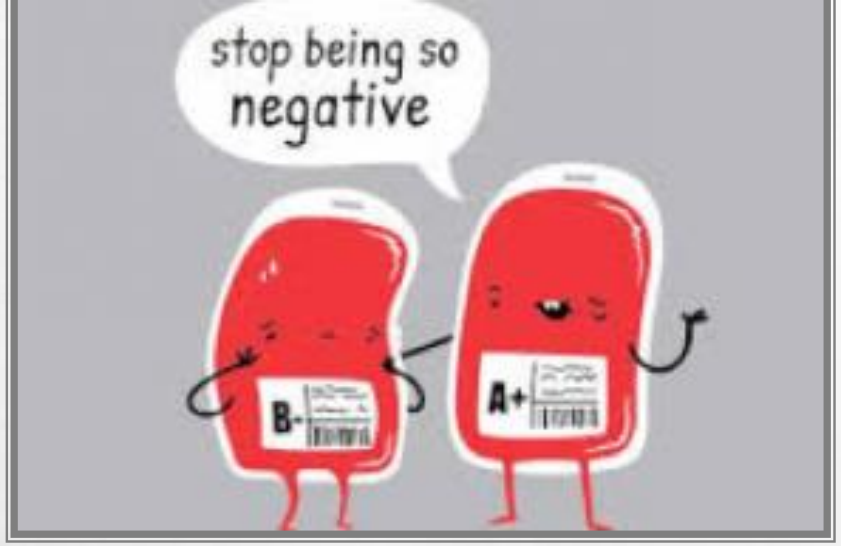
Blood Type	Gives	Receives
A+	A+, AB+	A+, A-, O+, O-
O+	O+, A+, B+, AB+	O+, O-
B+	B+, AB+	B+, B-, O+, O-
AB+	AB+	Everyone
A-	A+, A-, AB+, AB-	A-, O-
O-	Everyone	O-
B-	B+, B-, AB+, AB-	B-, O-
AB-	AB+, AB-	AB-, A-, B-, O-



RH FACTOR



- ALL PATIENTS WHO ARE **RH NEGATIVE AND HAVE RECEIVED O+ BLOOD** ARE CANDIDATES FOR RHOGAM ADMINISTRATION **WITHIN 72 HOURS** OF EXPOSURE
- IMPORTANT TO RELAY TO RECEIVING FACILITIES



TYPE AND CROSS

- SAMPLE FROM PATIENT AND DONOR BLOOD MIXED PRIOR TO TRANSFUSION TO ENSURE ABSENCE OF REACTION

- IN THE ABSENCE OF SUCH LUXURIES (I.E. YOUR PATIENT IS EXSANGUINATING) **TYPE O BLOOD MAY BE GIVEN.**
- O NEGATIVE-IDEAL
- O POSITIVE-NEXT BEST THING

PATIENT SELECTION

- TYPES OF PATIENTS THAT MAY REQUIRE EMERGENT TRANSFUSION:
  - ANY PATIENT SUFFERING FROM ***SIGNIFICANT AND ACUTE BLOOD LOSS WITH HEMODYNAMIC COMPROMISE*** RESULTING FROM:
    - TRAUMA
    - GI BLEED
    - POSTPARTUM HEMORRHAGE
    - RUPTURED ANEURYSM
    - POST-SURGICAL COMPLICATIONS

HOW MUCH BLOOD IS THAT??

Organ/area	Estimated blood loss [ml]
Pelvis	3000–5000
Spleen	2000
Liver	2000
Femoral fracture	1500–2000
Lungs	1000–1500
Tibia/fibula fracture	1000
Humerus fracture	800
Radius/ulna fracture	400
Rib	125


TACMED
AUSTRALIA

5750mL

DETERMINING NEED

- Judicious patient selection is imperative for the prehospital provider
- Can hemorrhage be controlled? Compressible vs noncompressible site
- Mental status
- Tachycardia
- Hypotension
- Suspected major internal hemorrhage
- Calculate shock index: HR/SBP>1=PROBLEM

CONSIDER OTHER FACTORS

- AGE
- ABILITY TO COMPENSATE
- WHAT ELSE CAUSES HYPOTENSION/TACHYCARDIA?

OKAY THEY DEFINITELY NEED IT, NOW WHAT?

- IF YOU DETERMINE YOUR PATIENT NEEDS BLOOD ***CONSIDER MEDEVAC DEPLOYMENT***

NEXT STEPS

- DON'T FORGET ALL OF THE OTHER NORMAL INTERVENTIONS FOR TRAUMA PATIENTS
  - ENSURE BLEEDING IS CONTROLLED (IF COMPRESSIBLE)
  - CONSIDER PELVIC BINDER
  - ENSURE DEDICATED IV ACCESS FOR BLOOD PRODUCT (LARGE BORE IS BEST!
  - MACROBORE EXTENSION SET WITH CAP REMOVED
  - TXA FOR ALL THAT MEET CRITERIA
  - OBTAIN BASELINE VS AND TEMPERATURE
  - CONSIDER MEDEVAC DEPLOYMENT AND DESTINATION FACILITY (LEVEL 1)

ADMINISTRATION

- VISUALLY INSPECT THE BLOOD
- DOES THE UNIT FEEL COLD? STORED @ 1-6C (HEMOTRAC FOR >10C)
- INSPECT FOR ABNORMALITIES:
  - CELLULAR AGGREGATES
  - AIR BUBBLES
  - COLOR (BLACK=BACTERIAL CONTAMINATION)

ADMINISTRATION

- VERIFY PRODUCT TYPE (O POS)
- HEMO-TRAC BLOOD TEMPERATURE INDICATOR
- WHOLE BLOOD
- NOTE VOLUME
- EXPIRATION DATE WITHIN RANGE?
- OBTAIN UNIT # OFF OF BAG

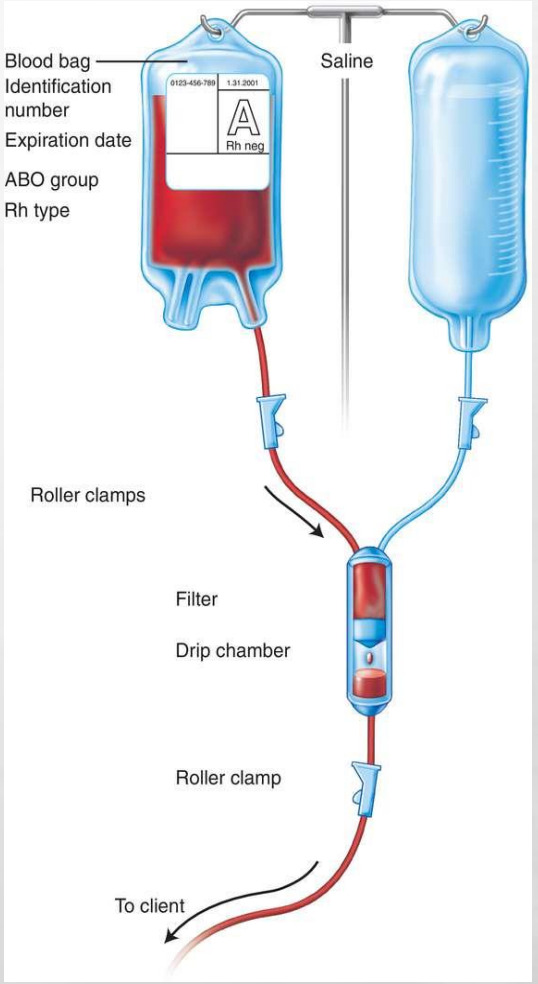
ADMINISTRATION: DOSING

Adults: 1 unit (450 +/-50ml)

Pediatrics: 10ml/kg

ADMINISTRATION: PRIMING

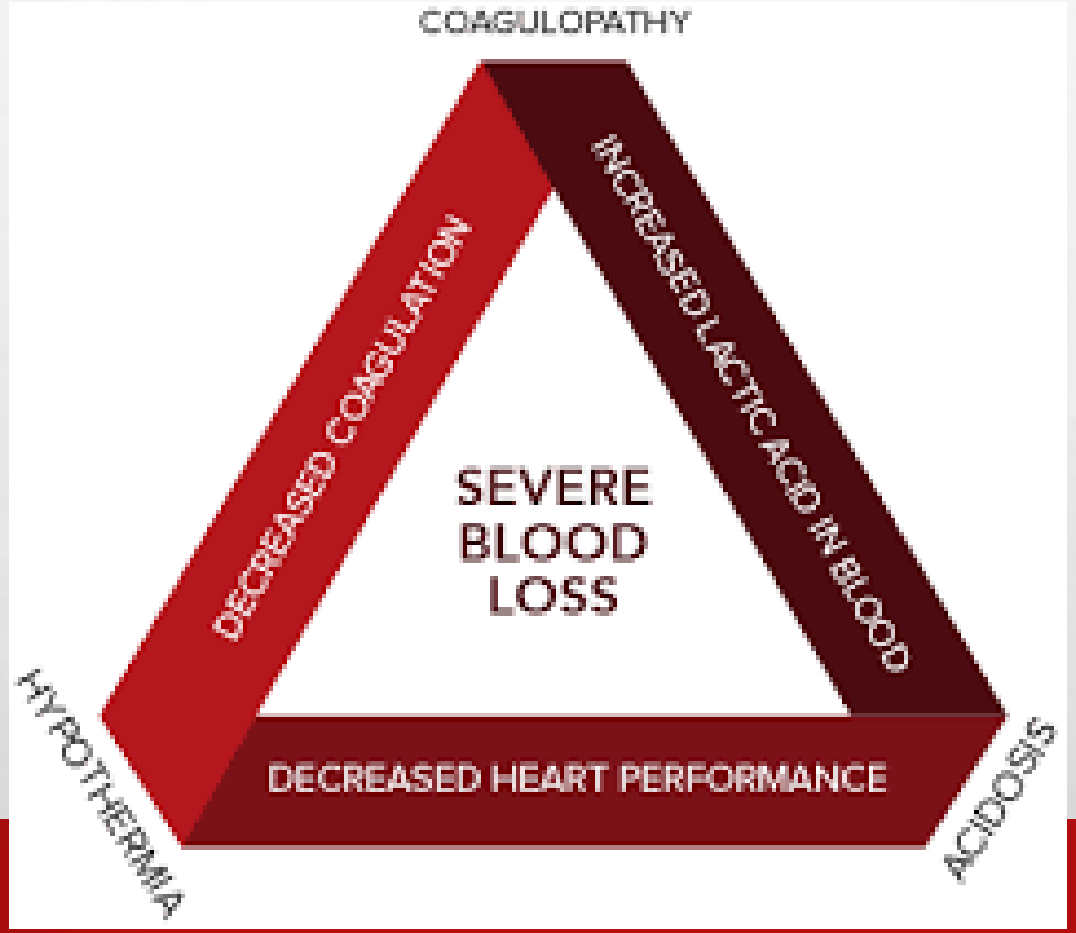
- FILTERED BLOOD TUBING MUST BE USED (YES EVEN IN DIRE EMERGENCIES!)
- FILTERS OUT WHITE BLOOD CELLS, CLOTS, FIBRIN STRANDS
- ALWAYS PRIME WITH SALINE TO COAT TUBING AND FACILITATE RAPID INFUSION
- FLUSH TUBING BETWEEN PRODUCT
- COVER FILTER WITH SALINE



PREVENTING HEMOLYSIS

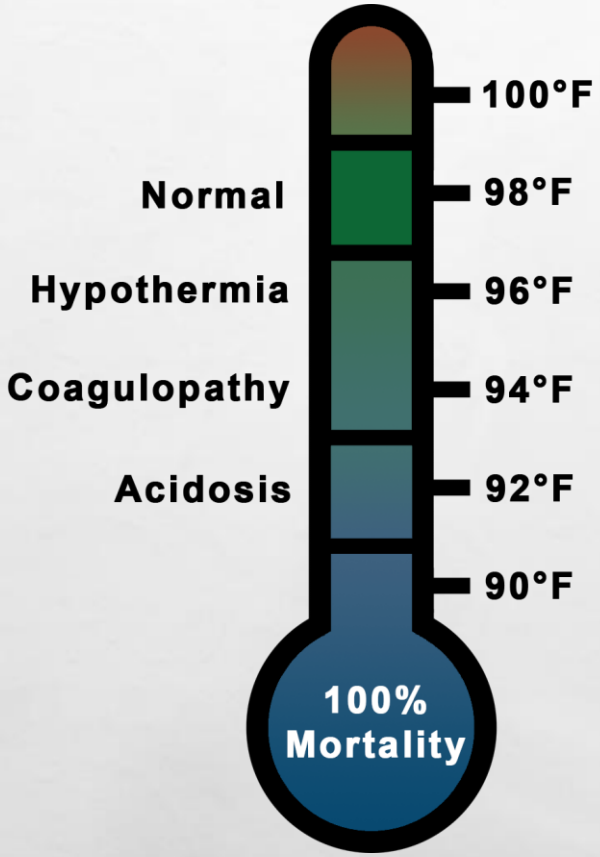
- HEMOLYSIS=RBCS BREAK APART. BROKEN RED CELLS CAN'T TRANSPORT 02
- RISK FACTORS: HARSH HANDLING OF BLOOD PRODUCT, USE OF RAPID INFUSERS OR PRESSURE DEVICES, SMALL IV LUMENS
- ENSURE PRESSURE BAG NEVER EXCEEDS 300MMHG
- ENSURE ADEQUATE IV ACCESS TO AVOID HEMOLYSIS AT THE IV SITE THROUGH SMALL LUMEN

TRAUMA TRIAD OF DEATH



TRAUMA DIAMOND OF DEATH

- COLD BLOOD KILLS
- WARM YOUR PATIENT AND WARM YOUR BLOOD!

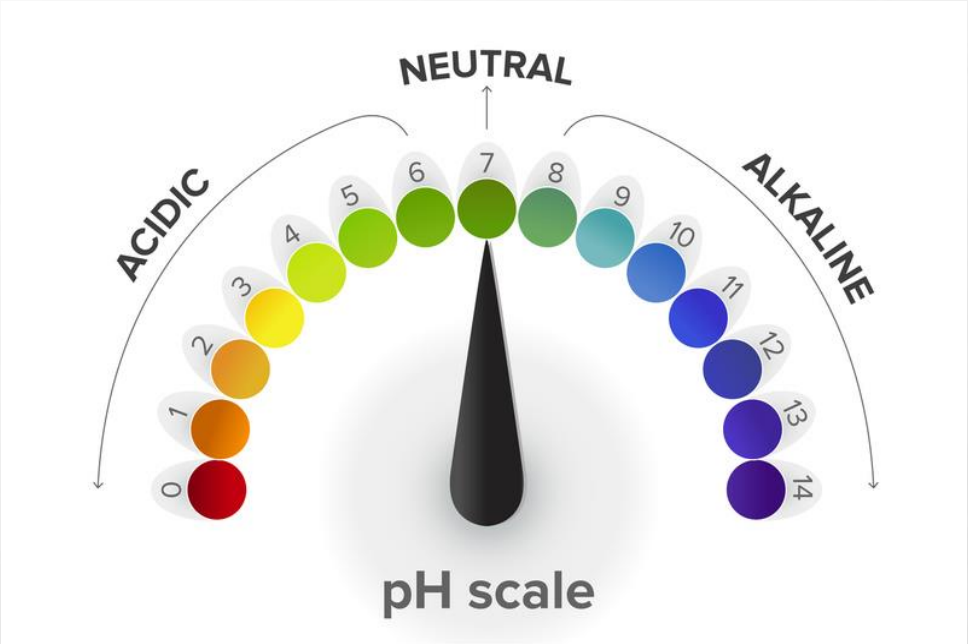


HYPOTHERMIA

- HYPOTHERMIA IN THE TRAUMA PATIENT DIRECTLY PREDICTS A POOR OUTCOME
- EVEN MILD HYPOTHERMIA CAN RESULT IN *DEVASTATING PHYSIOLOGIC CONSEQUENCES*
- *COAGULATION SYSTEM IS TEMPERATURE AND PH SENSITIVE.* CORE TEMP GOES DOWN=SO DOES THE BODY'S ABILITY TO CLOT

ACIDOSIS

- POOR PERFUSION=LACTIC ACIDOSIS
- PH GOES DOWN, WORSENING COAGULATION
- THIS CAN OCCUR EVEN WITH NORMAL VITAL SIGNS

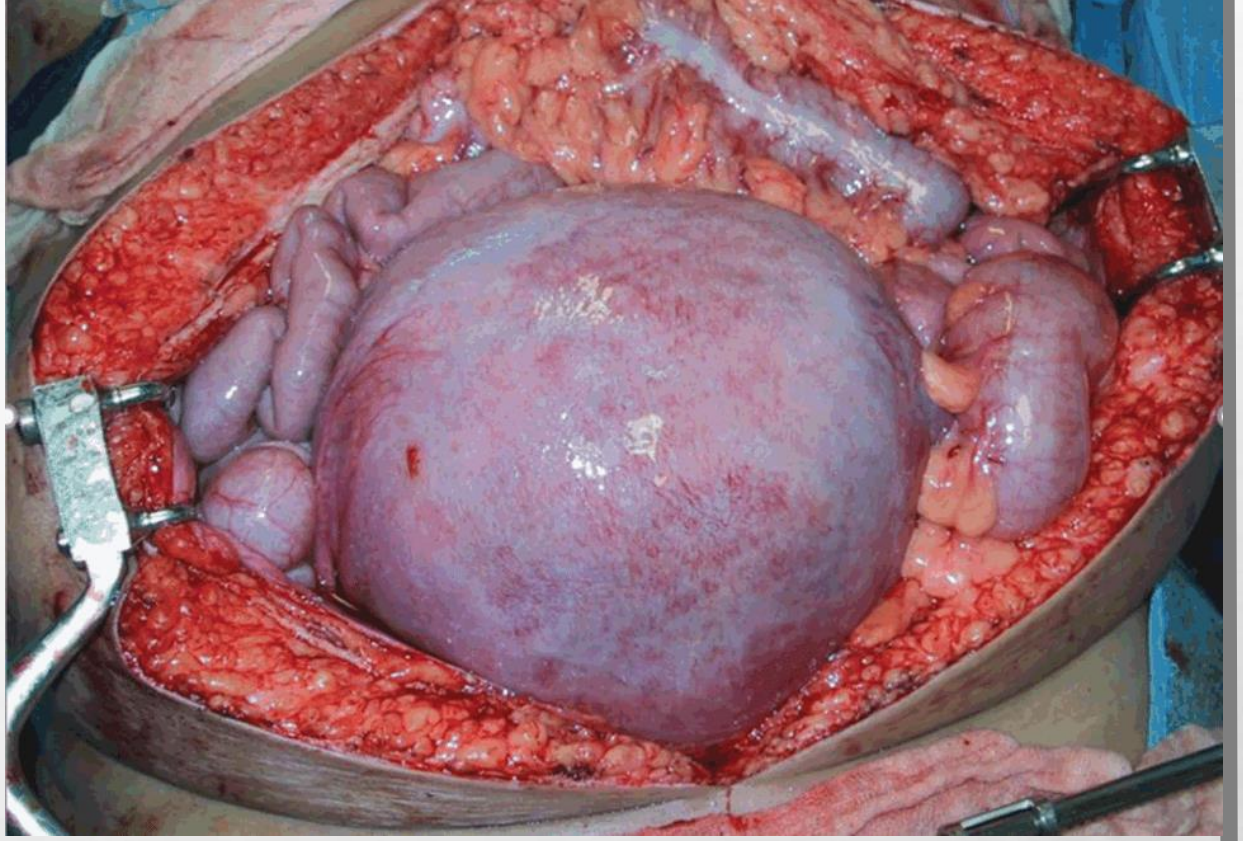


COAGULOPATHY

- AFOREMENTIONED ITEMS
- CLOTTING FACTORS LOST WITH INITIAL HEMORRHAGE
- CALCIUM REPLACEMENT GAINING TRACTION

DIC

- DISSEMINATED INTRAVASCULAR COAGULATION
- **CONSUMPTION COAGULOPATHY** OR ABNORMAL ACTIVATION OF CLOTTING CASCADE
- SEPSIS, MALIGNANCY, AND TRAUMA CAN CAUSE THE RELEASE OF A PROCOAGULANT THAT TIPS THE SCALES IN FAVOR OF CLOT FORMATION
- SIMULTANEOUS CONSUMPTION OF ALL PLATELETS AND CLOTTING FACTORS WITH INCREASE IN FIBRIN DEGREDATION PRODUCTS, WORSENING BLEEDING



SPECIAL CONSIDERATIONS: PREGNANCY

- HYPERVOLEMIC AND HYPERDYNAMIC STATE
- HYPOTENSIVE WHEN SUPINE
- HYPERCOAGULABLE
- BASELINE INCREASED HEART RATE

PEDIATRIC PATIENTS

- COMPENSATORY MECHANISMS DIFFER
- LESS RESERVE
- KNOW NORMAL VITAL SIGN PARAMETERS
- TREAT HYPOTENSION AGGRESSIVELY

LIFE FLOW DEVICE

- ADDS THE ABILITY TO DELIVER PRECISE DOSING TO PEDIATRIC PATIENTS
- IO PATIENTS

JEHOVAH'S WITNESSES

- MAY REFUSE BLOOD PRODUCTS
- ERYTHROPOIETIN TO STIMULATE RBC PRODUCTION

ALL HEMORRHAGING PATIENTS GET WHAT?

HEMORRHAGE CONTROL

TXA (IF THEY MEET CRITERIA) 2GM SLOW IV

PRIORITIZE BLOOD TRANSFUSION WITH DEDICATED LINE

100% FIO2

TRANSFUSION REACTIONS (VERY RARE)

- TYPES:
  - FEVER
  - SEPSIS
  - ALLERGIC REACTION
  - ACUTE HEMOLYTIC REACTION
  - BLOOD-BORNE INFECTIONS
  - TRANSFUSION-RELATED ACUTE LUNG INJURY (TRALI)
  - CHF
  - GRAFT VS. HOST DISEASE-DELAYED

WHAT TO LOOK FOR

Baseline Temperature imperative

Q 10 min VS to include temp

Monitor for cp, back/flank pain, sob, hives, itching, nausea, AMS, fever

TRANSFUSION REACTIONS

If a transfusion reaction is suspected, stop the transfusion, remove the iv tubing, and begin flushing with ns immediately

Treat per allergic reaction protocol

Turonver unused blood product to receving facility

TURNOVER OF CARE

- RECEIVING PHYSICIAN MUST BE MADE AWARE OF O+ BLOOD PRODUCT ADMINISTRATION

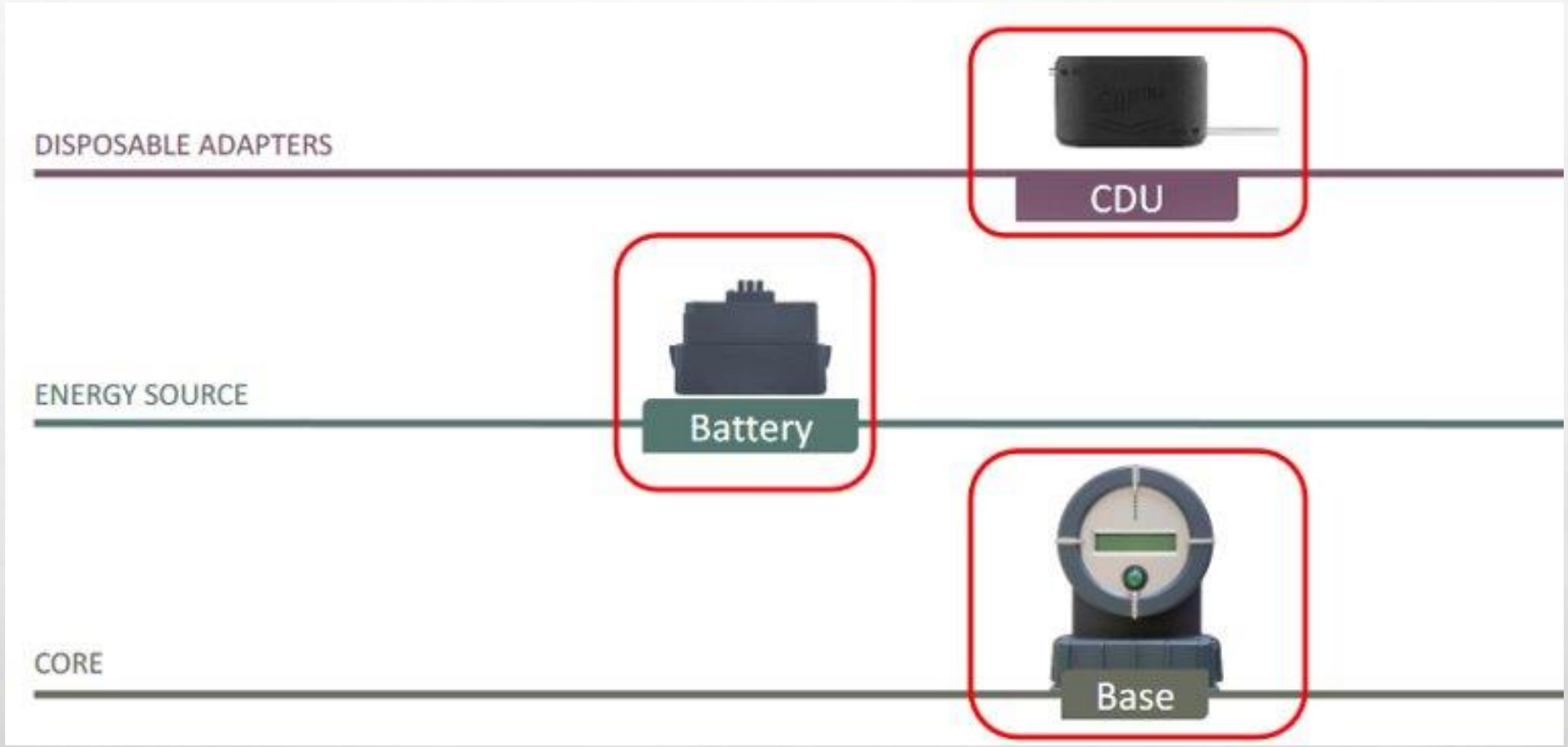
QINFLOW WARMER

- "QUALITY IN FLOW"
- BLOOD AND IVF WARMER
- ANY INPUT TEMP
- OUTPUT TEMP 100.4/38C WITHIN SECONDS
- NOT A PUMP

BASE UNIT

- NO MAINTENANCE OUTSIDE CHARGING BATTERIES
- 5-YEAR SHELF LIFE
- ON/OFF BUTTON ON THE BACK
- FULLY CHARGED BATTERY WARMS 3.5 L OF BLOOD OR 5L IVF
- VISUAL AND AUDIBLE INDICATIONS
- POSITIONING-OPERATES VERTICALLY OR HORIZONTALLY, OPTION AVAILABLE FOR MOUNTING
- ADVANCED SAFETY CAPABILITIES TO IDENTIFY REVERSED FLOW, AIR BUBBLES, OR BLOCKAGES

- ON SWITCH IS ON THE BACK
- FRONT BUTTON IS ONLY A MUTE OR SELF TEST BUTTON


DISPOSABLE ADAPTERS
CDU
ENERGY SOURCE
Battery
CORE
Base

COMPACT DISPOSABLE UNIT (CDU)

- STERILE SINGLE USE UNIT
- EXTENSION CONNECTED TO IV OR BLOOD TUBING
- QINFLOW BASE UNIT POWER CABLE CONNECTS TO CDU
- CDU DOES NOT REGULATE FLOW IN ANY WAY
- 19 ML PRIMING VOLUME
- CAN BE USED WITH PRESSURE BAG
- REPLACE CDU WHEN YOU REPLACE BLOOD TUBING (4 UNITS)

BATTERY

- CONNECTS TO BASE UNIT ONE WAY ONLY
- LATCHES IN PLACE
- BATTERY LIFE UP TO 400 CHARGE CYCLES
- 3 HOURS TO CHARGE
- IF NOT CHARGED FOR 3 MONTHS BATTERY WILL ENTER HIBERNATION MODE AND MUST BE SHIPPED BACK TO MANUFACTURER

The system is heating the fluids:

- Outgoing fluid temperature (Tout): 38^{0}C
- Incoming fluids temperature: 11^{0}C

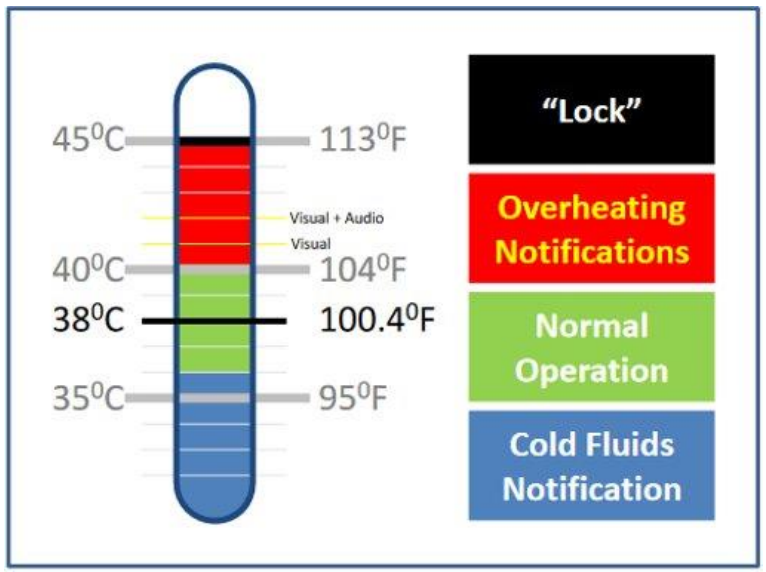
Icon indications:

Battery is ¾ full

System unmuted

- COMMON IN OUR DYNAMIC ENVIRONMENT
- CHECK INFUSION LINE FOR KINKS
- REPLACE INFUSION LINE PRN

- STEADY BEEP WILL ALARM
- FLOW IRREGULARITIES, BACK FLOW, LARGE AIR BUBBLES OR SUDDEN CHANGE IN RATE
- IF NONE OF THESE IS PRESENT REPLACE CDU



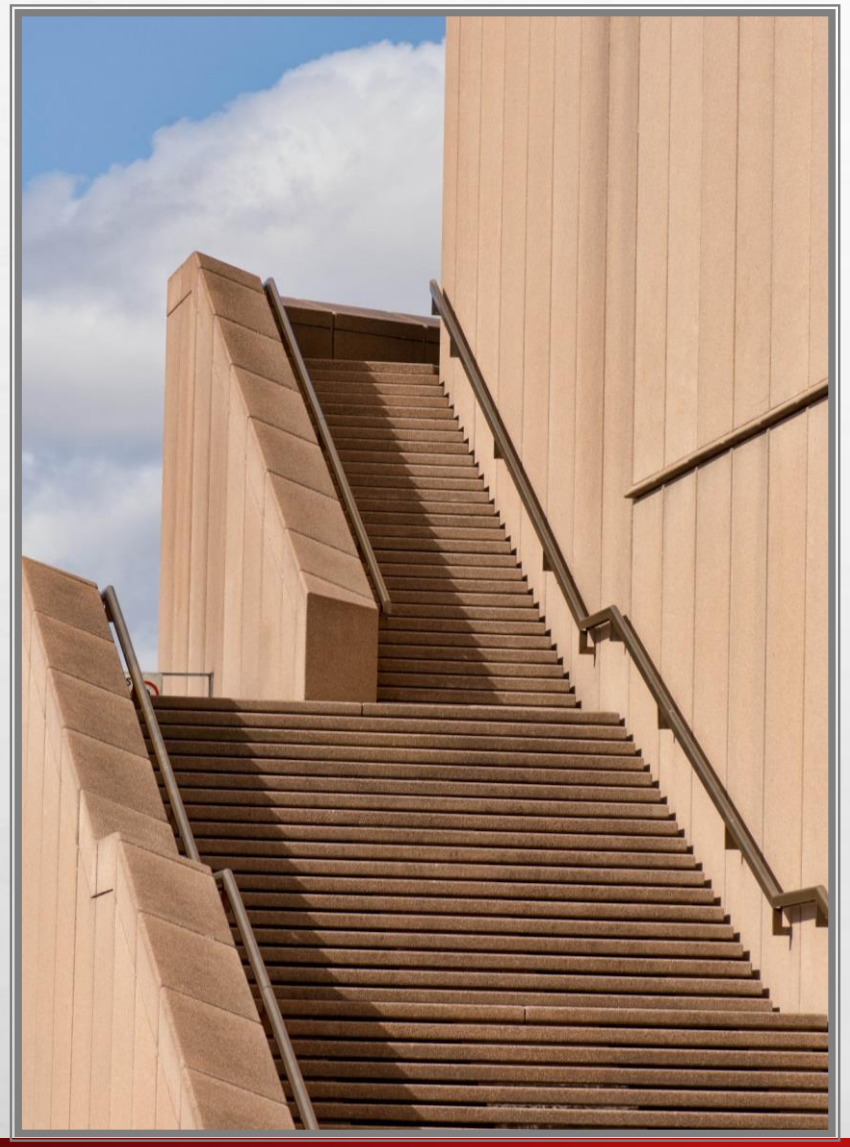
- SET TEMP IS 38
- WILL ALERT IF OUTGOING TEMP (T OUT) EXCEEDS OR FALLS BELOW THIS TEMP
- DESIGNED TO PREVENT OVERHEATING THAT WILL IMPACT BLOOD/FLUID QUALITY
- WHEN DECREASED FLOW IS DETECTED, WARMING WILL DECREASE AUTOMATICALLY
- IF TEMP EXCEEDS 45F SYSTEM WILL LOCK AND INDICATE MALFUNCTION

CLEANING

- NO BLEACH
- CDU DISPOSABLE AND SINGLE-PATIENT USE
- USE CAVICIDE ON ALL REUSABLE COMPONENTS
- DON'T SUBMERGE

CASE # 1: MVC

- 22 YOM BELTED DRIVER HEAD ON COLLISION AT A HIGH RATE OF SPEED WITH PROLONGED EXTRICATION TIME (35MIN)
- +LOC REPORTED, +AIRBAG DEPLOYMENT, TQ TO BLE AT TIME OF EXTRICATION FOR OPEN TIB/FIB FX WITH "SIGNIFICANT HEMORRHAGE."
- VS: GCS 13 (E3, V4, V6) BP 106/58 HR 122, RR 28, SAT 95% ON 4 LPM
- DIMINISHED LUNG SOUNDS BILATERAL, TTP ABDOMEN, SOFT, TTP PELVIS



CASE # 2: FALL

- 72 YOF FELL DOWN 12 CONCRETE STAIRS.
- NO LOC. C/O SEVERE PAIN TO THE LEFT HIP AND LEFT FEMUR. OBVIOUS CLOSED LEFT FEMUR FX WITH DECREASED SENSATION DISTALLY, +DP PULSE.
- VS: BP 86/60, HR 88, RR 22, SAT 96%.

CASE # 3: GSW TO THE ABDOMEN

- 34 YOM WITH INJURIES FROM ASSAULT. NOTED TO BE BEATEN WITH A BASEBALL BAT AND SUBSEQUENTLY SHOT AT CLOSE RANGE TO THE ABDOMEN IN THE AREA OF THE UMBILICUS.
- PT RESPONSIVE, CONFUSED C/O ABDOMINAL PAIN. BLUNT TRAUMA NOTED TO UPPER EXTREMITIES, GSW TO ABDOMEN NOTED WITH MODERATE BLEEDING FROM THE SITE.
- VITAL SIGNS: 75/40, HR 55, RR 28, SAT 92%

CASE # 4: PEDESTRIAN STRUCK

- 58 YOM PEDESTRIAN STRUCK BY PICKUP TRUCK GOING APPROXIMATELY 50MPH. +LOC.
- INITIAL ASSESSMENT: GCS 8 (E; 2 V; 2 M 4) LARGE LACERATION WITH BLEEDING CONTROLLED TO LEFT HEAD, +MANDIBLE FX, MISSING TEETH, BLOOD IN AIRWAY. +CREPITUS OVER LEFT CHEST, BRUISING TO ABDOMEN, LEFT FEMUR DEFORMITY, LEFT TIB/FIB DEFORMITY. L PUPIL SLUGGISH BUT RESPONSIVE.
- INITIAL VS: BP 130/60, HR 100, SAT 82%, RR IRREGULAR @ 8

CASE # 5: PEDIATRIC

- 5 YOF HELMETED BICYCLIST STRUCK A CURB AND EJECTED FORWARD STRIKING ABDOMEN ON HANDLEBARS.
- INITIAL INCIDENT X 3 HOURS AGO. PT C/O SEVERE ABDOMINAL
- VS: BP 70/48, HR 142, SPO2 99%, RR 30. CRYING WITH INITIAL ASSESSMENT. ABDOMEN ROUNDED, TENDER TO PALPATION. BRUISING NOTED TO LUQ AND L FLANK
- SHOCK INDEX, PEDIATRIC ADJUSTED (SIPA)

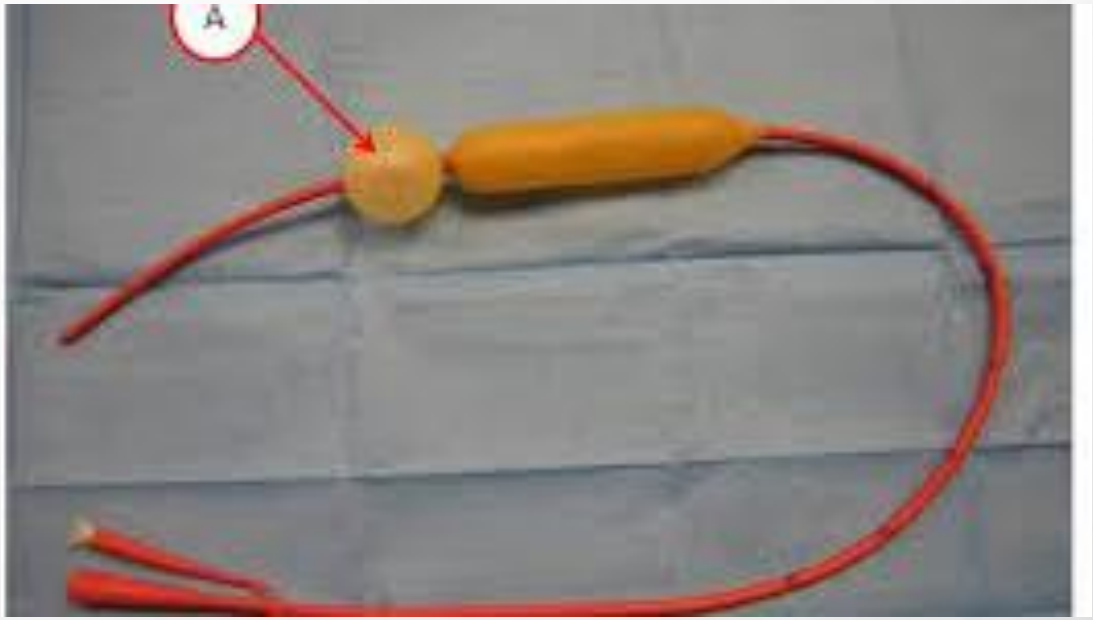
  4-6 YEARS = 1.2

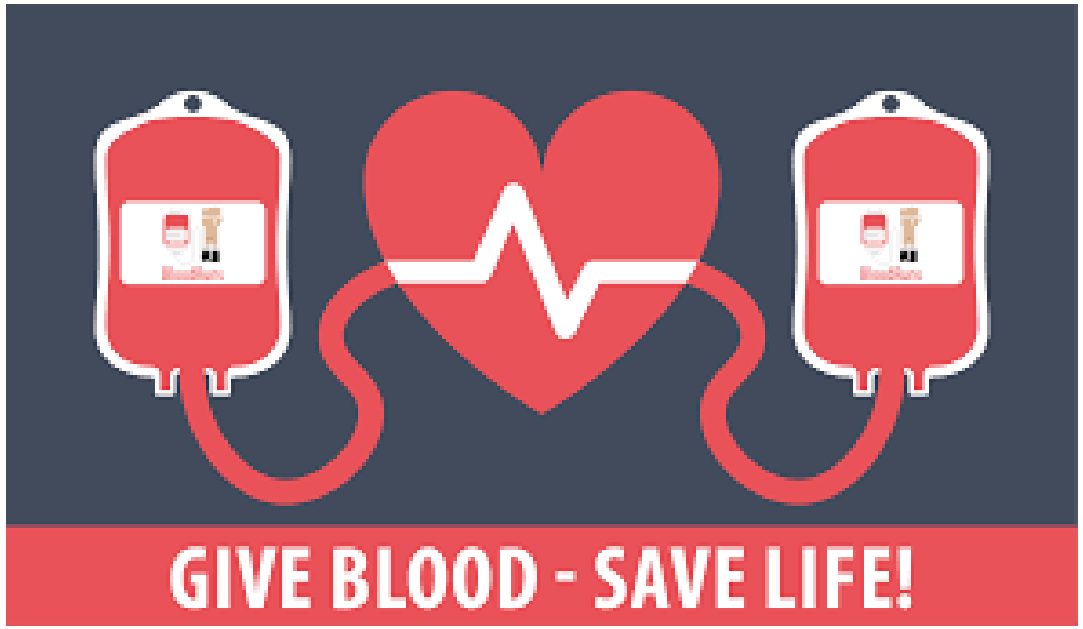
  6-12 YEARS = 1

  12 YEARS = 0.9

CASE # 6: GI BLEED

- 64 YOM KNOWN HX OF ESOPHAGEAL VARICES WITH MULTIPLE EPISODES OF BLACK TARRY STOOLS THIS AM FOLLOWED BY ONE EPISODE OF BRIGHT RED EMESIS
- INITIAL VS: BP 100/48, HR 110, RR 28, SPO2 93%, CONFUSED, SKIN PALE, COOL, DIAPHORETIC. NC ETCO2 28.





QUESTIONS?