Emergency Medicine for Rural and Indigenous Communities Conference

September 15th - 17th, 2022

The 1st 60 Minutes: Initial Management of the Critically Ill Infant

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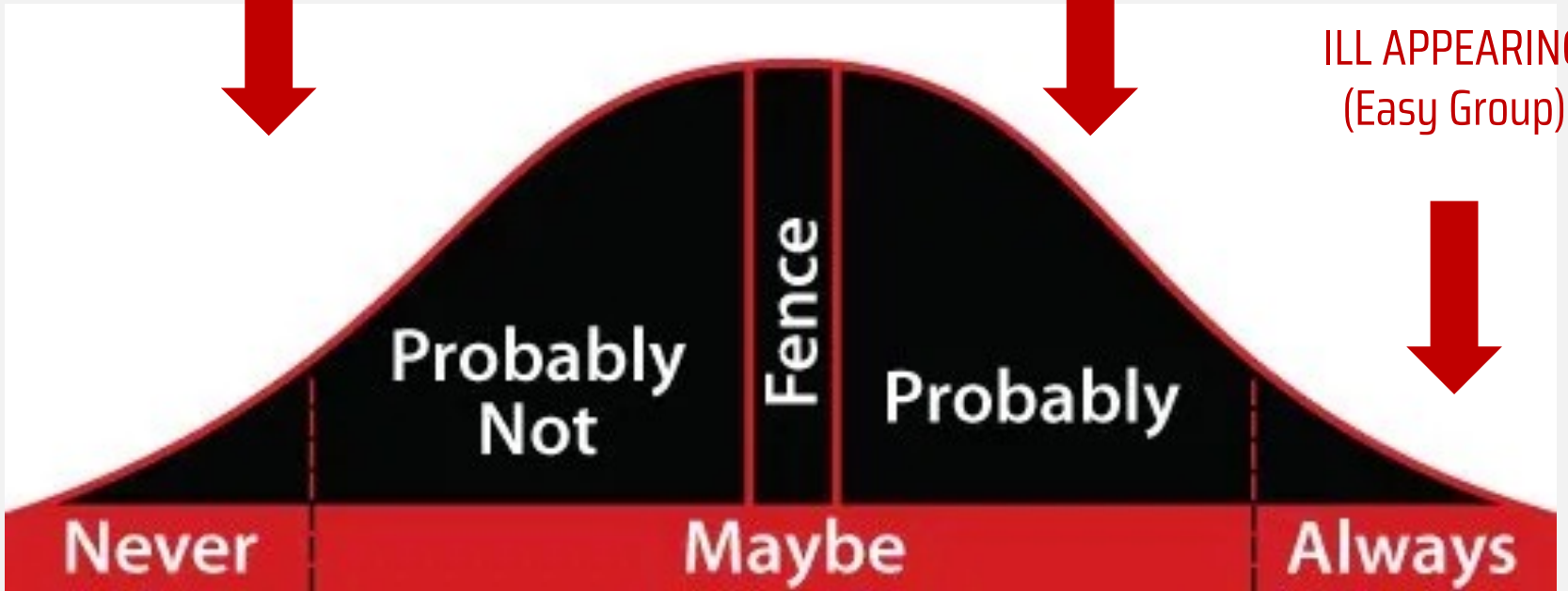
THE BELL CURVE OF INFANT SERIOUS ILLNESS

THE WELL APPEARING
(Easy Group)

TRANSITIONAL
APPEARANCE
(Difficult Group)

ILL APPEARING
(Easy Group)



GENERAL MANAGEMENT PRINCIPLES

THE "ABC'S" OF UNSTABLE INFANTS

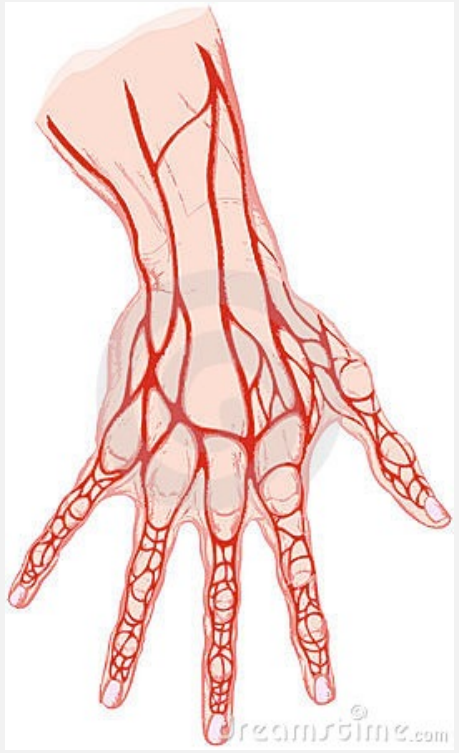
- Airway
  - Chin Lift + Jaw Thrust often neglected
  - Secretions may be obstructive
- Breathing
  - Good OSATs do NOT = ventilation
  - Grunting = Auto PEEP = need for intervention (more than oxygen)

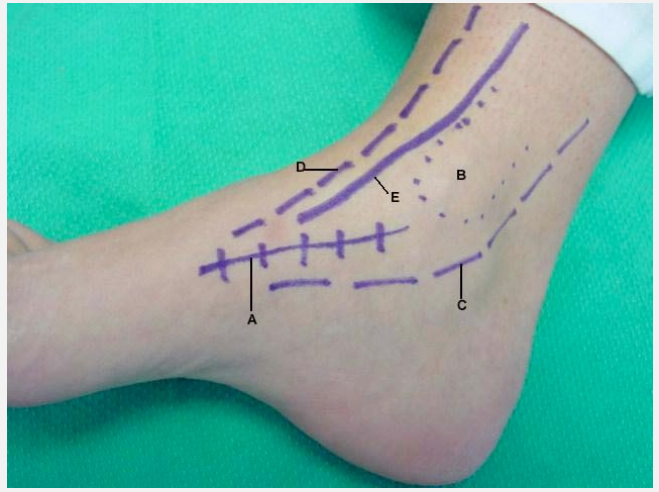
THE "ABC'S" OF UNSTABLE INFANTS

- Circulation
  - *EVERYONE* deserves a bolus
  - *ALL* critically ill infants are candidates for presumptive antibiotic therapy
    - *AFTER* obtaining blood and urine cultures

PROBLEM: VASCULAR ACCESS

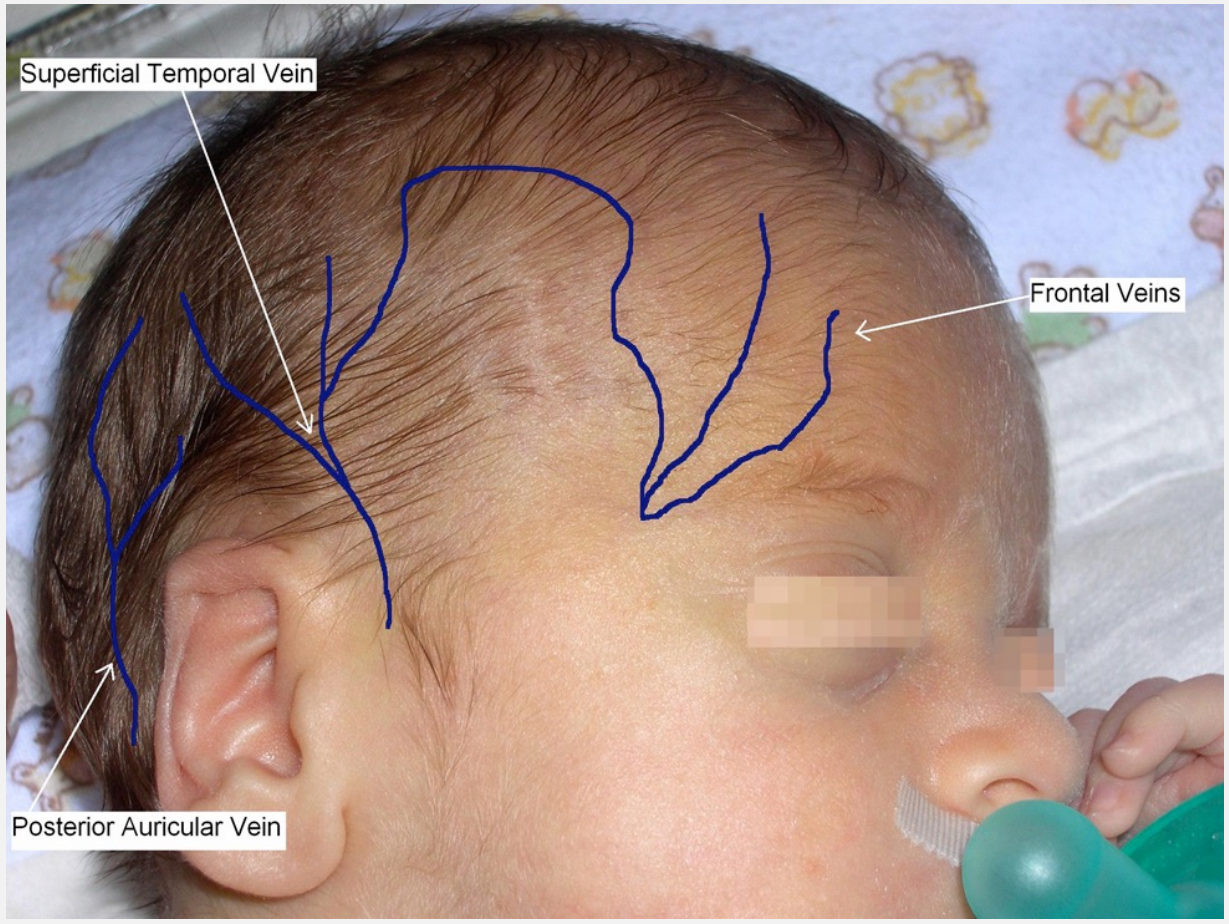
- Any interventions will necessitate vascular access
- What is available?
  - *The usual sites*
    - Hand
    - Antecubitus
    - Foot
    - Saphenous





PROBLEM: VASCULAR ACCESS

- Alternative Access in Infancy: ***Scalp Veins***



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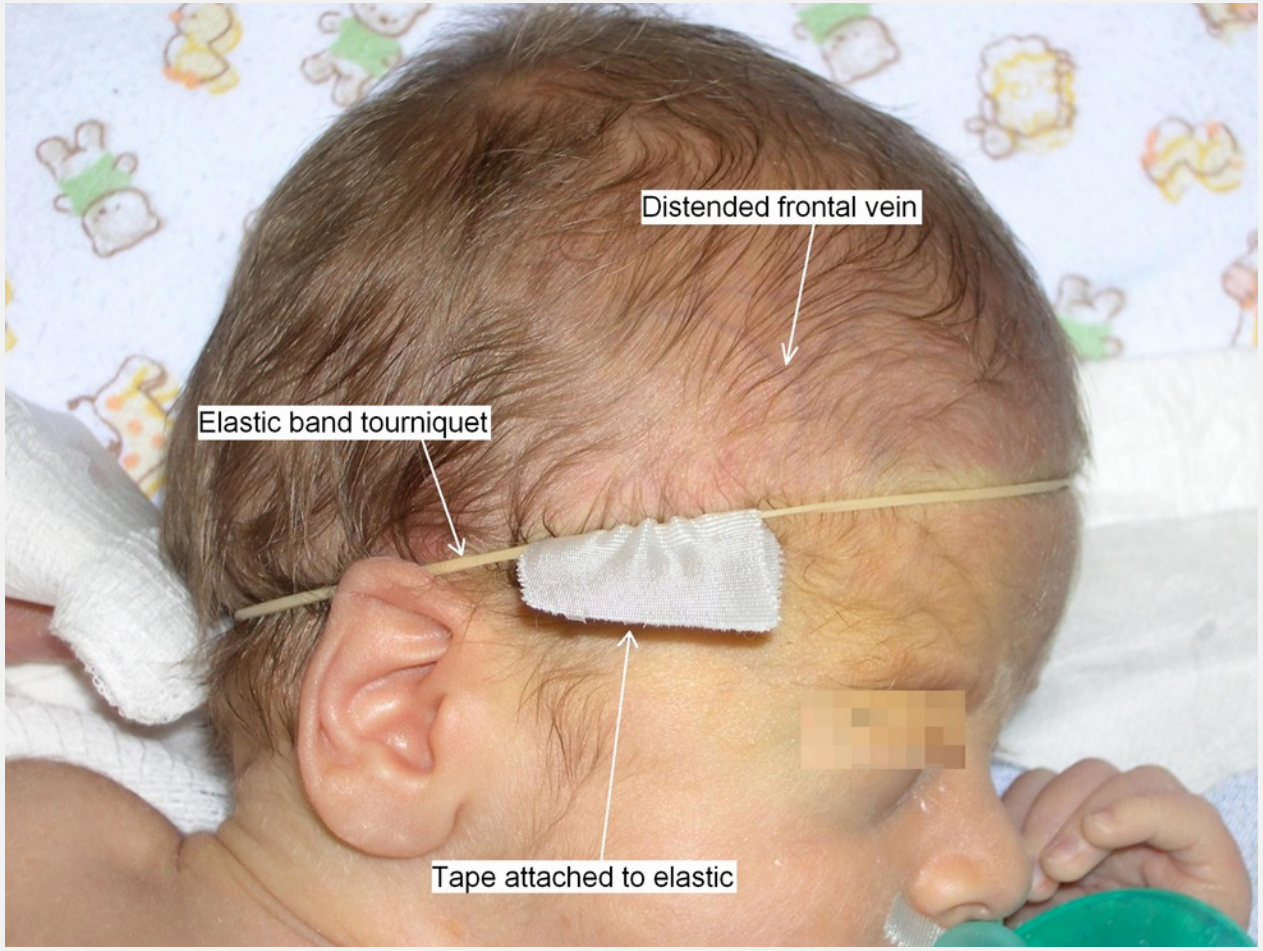
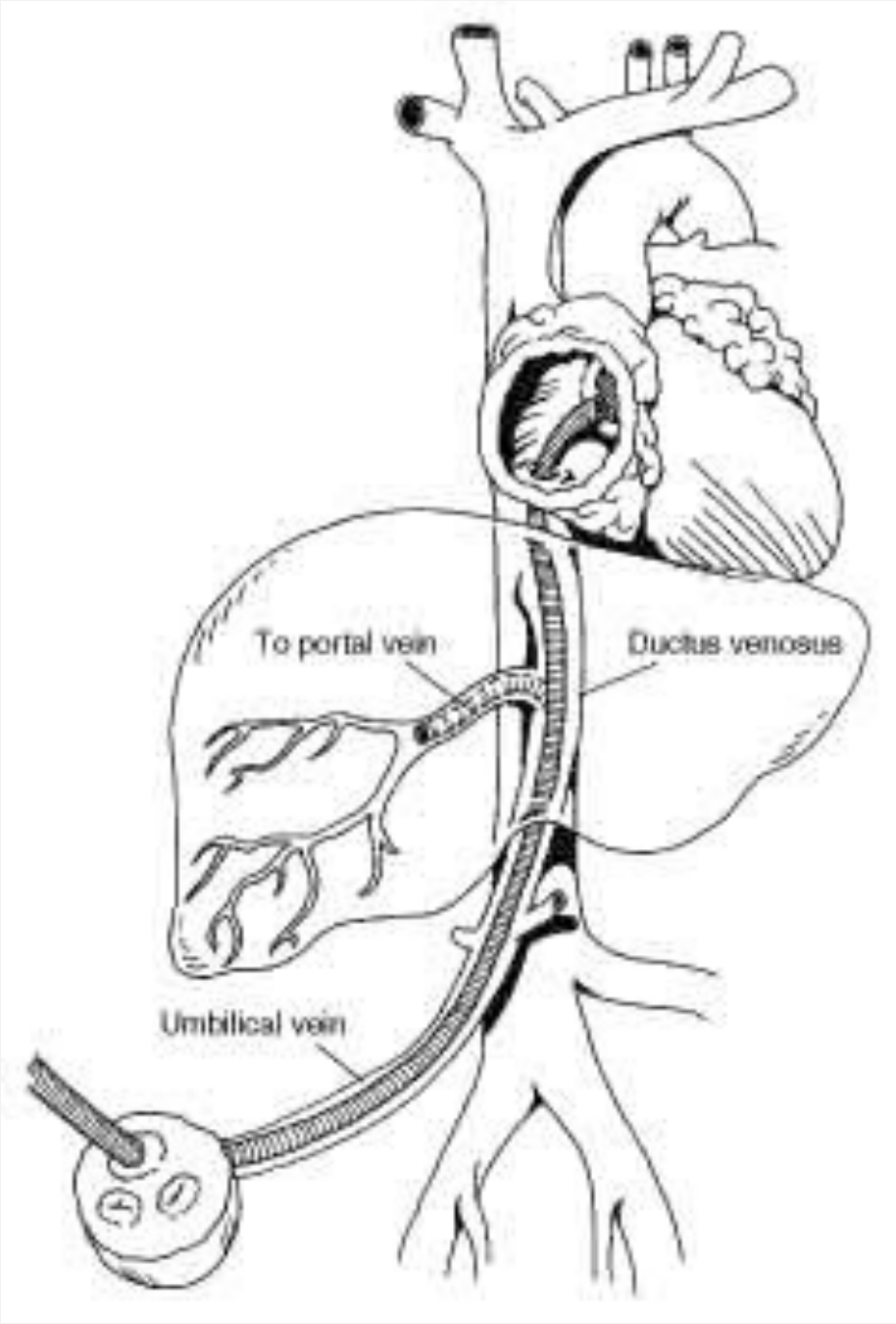


PROBLEM: VASCULAR ACCESS

- Alternative Access in *Infants Less Than 14 days*: Umbilical Vein Approach

PROBLEM: VASCULAR ACCESS



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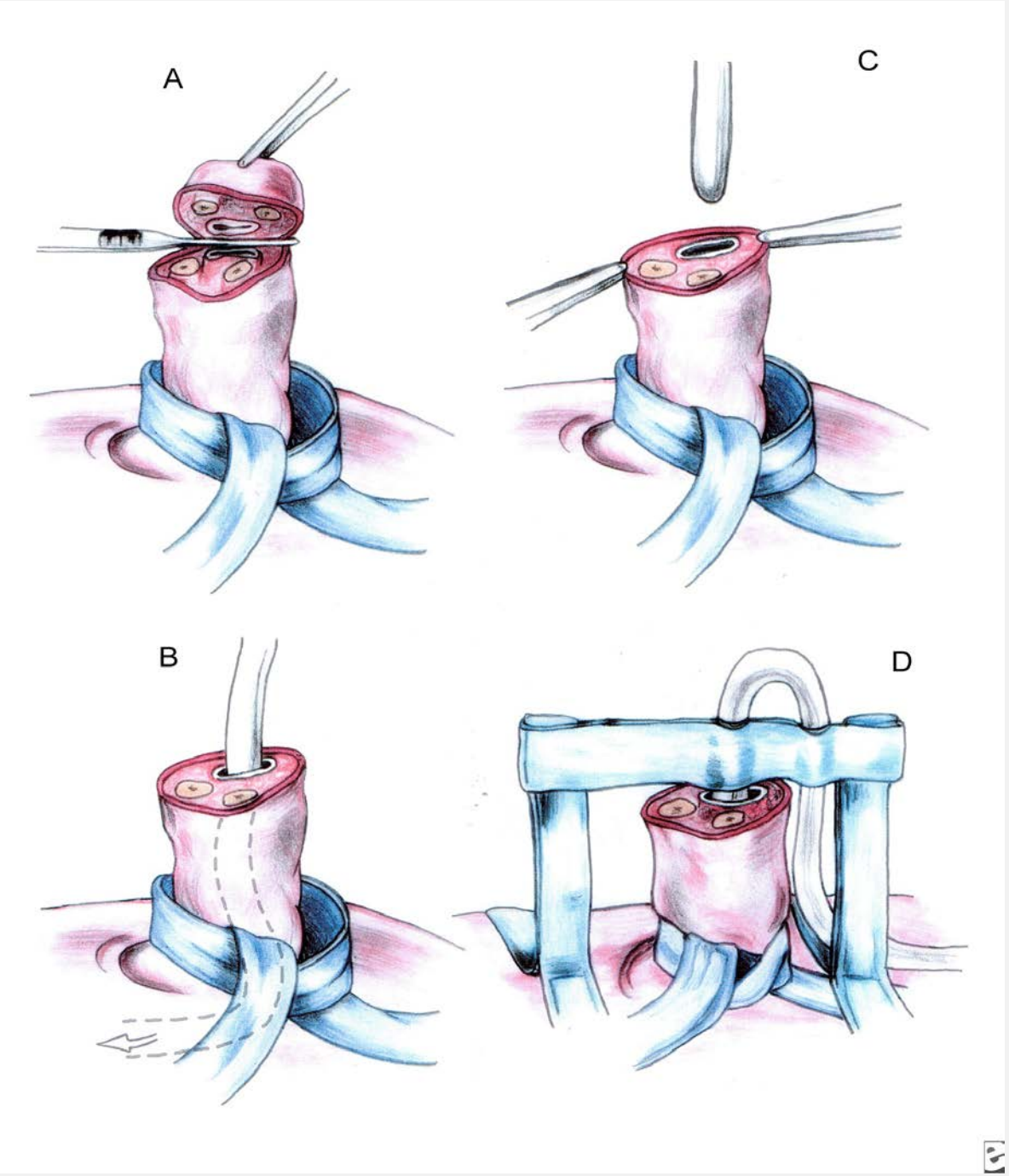

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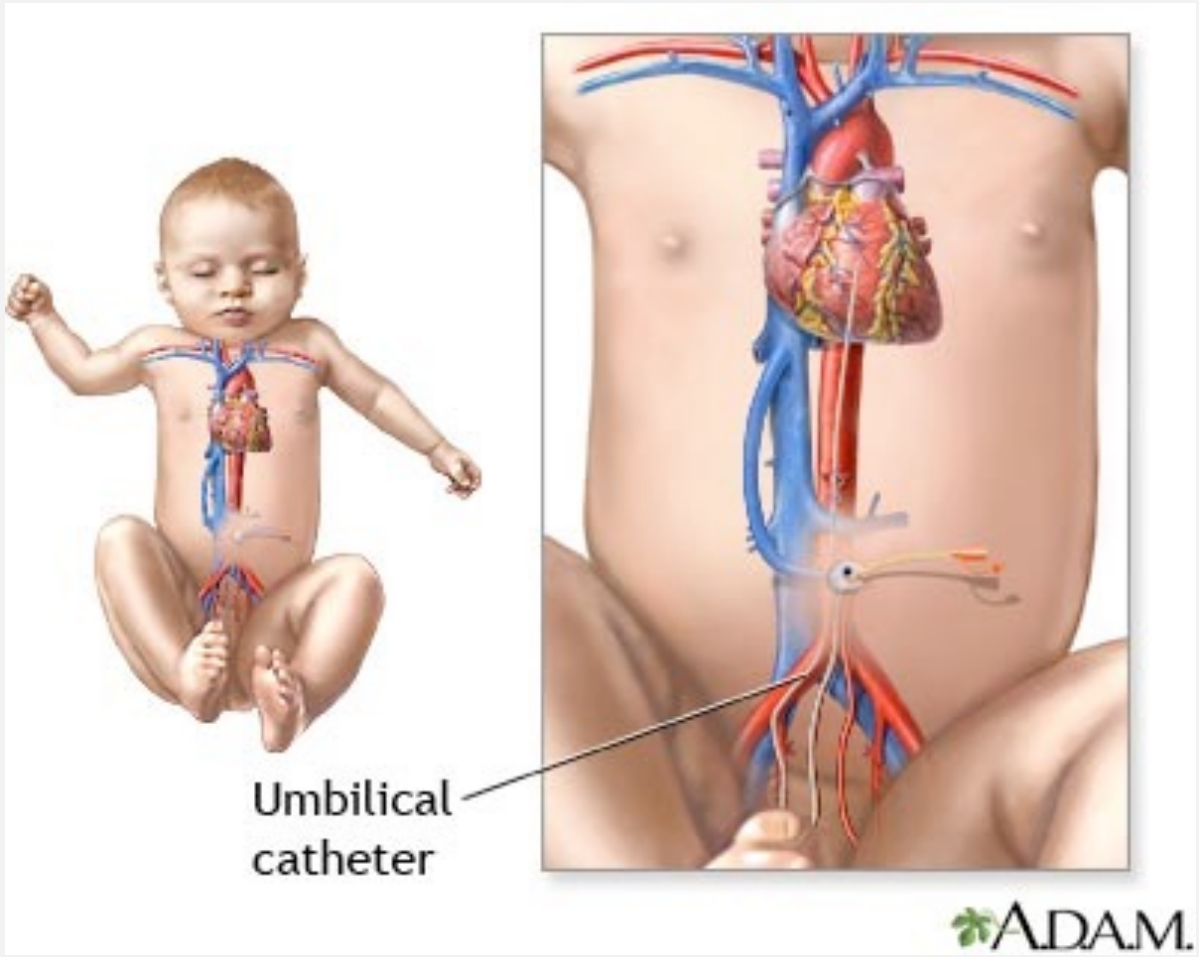
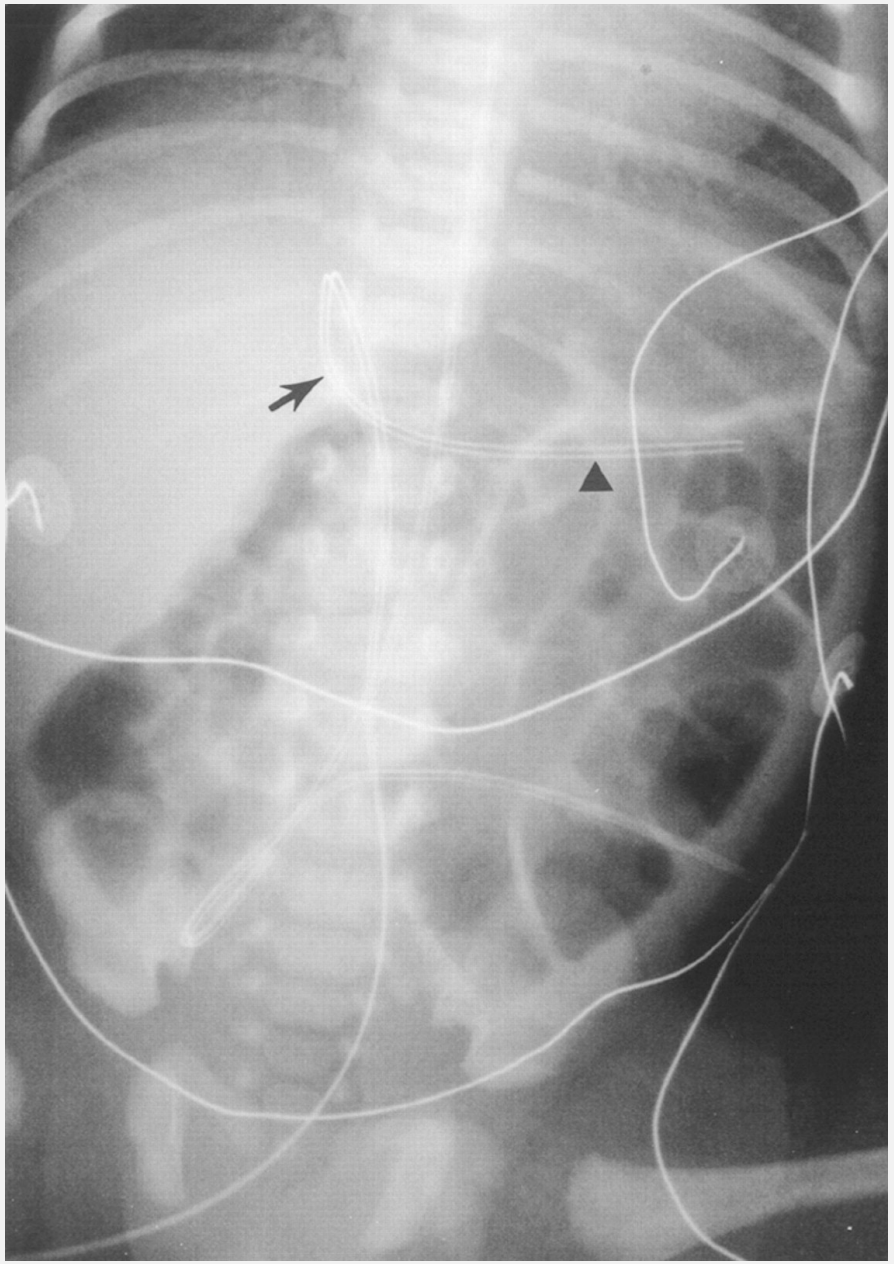
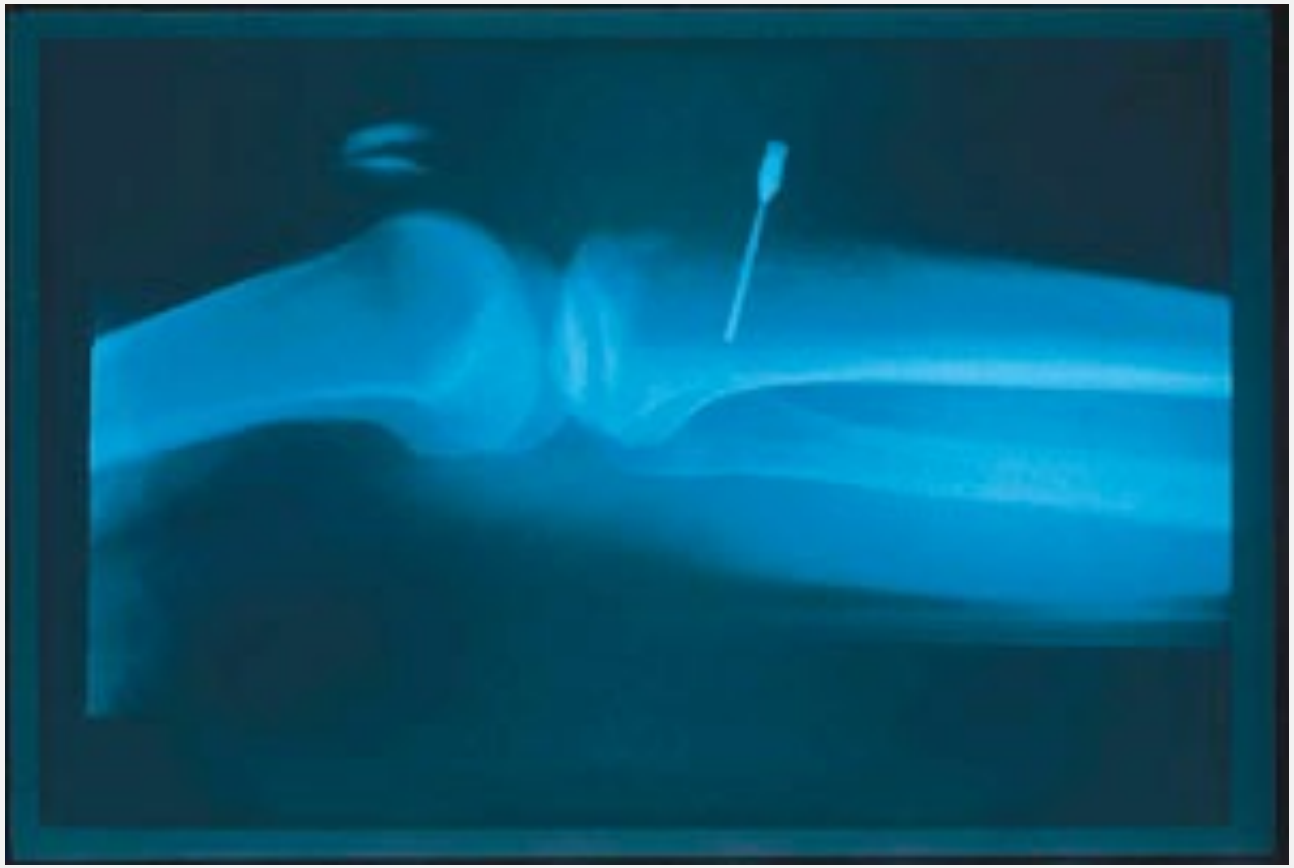




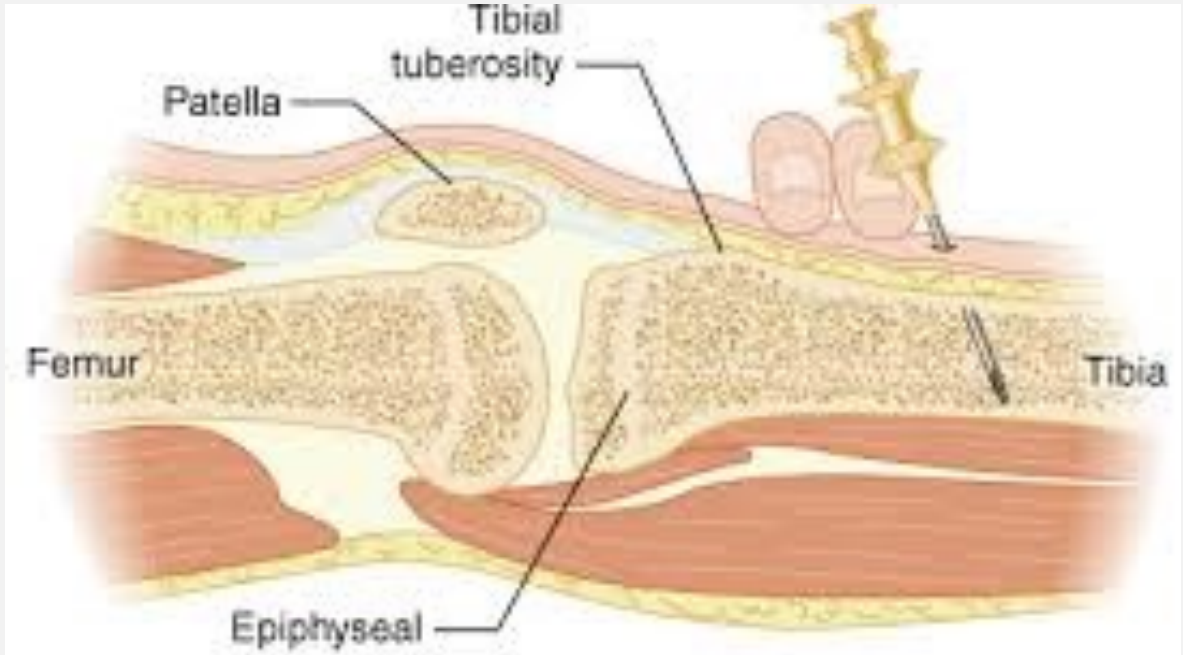
PROBLEM: VASCULAR ACCESS
INTRAOSSEOUS ACCESS

Figure 25-3 Various intraosseous needles.



PROBLEM: VASCULAR ACCESS
INTRAOSSEOUS ACCESS

- Intraosseous Approach

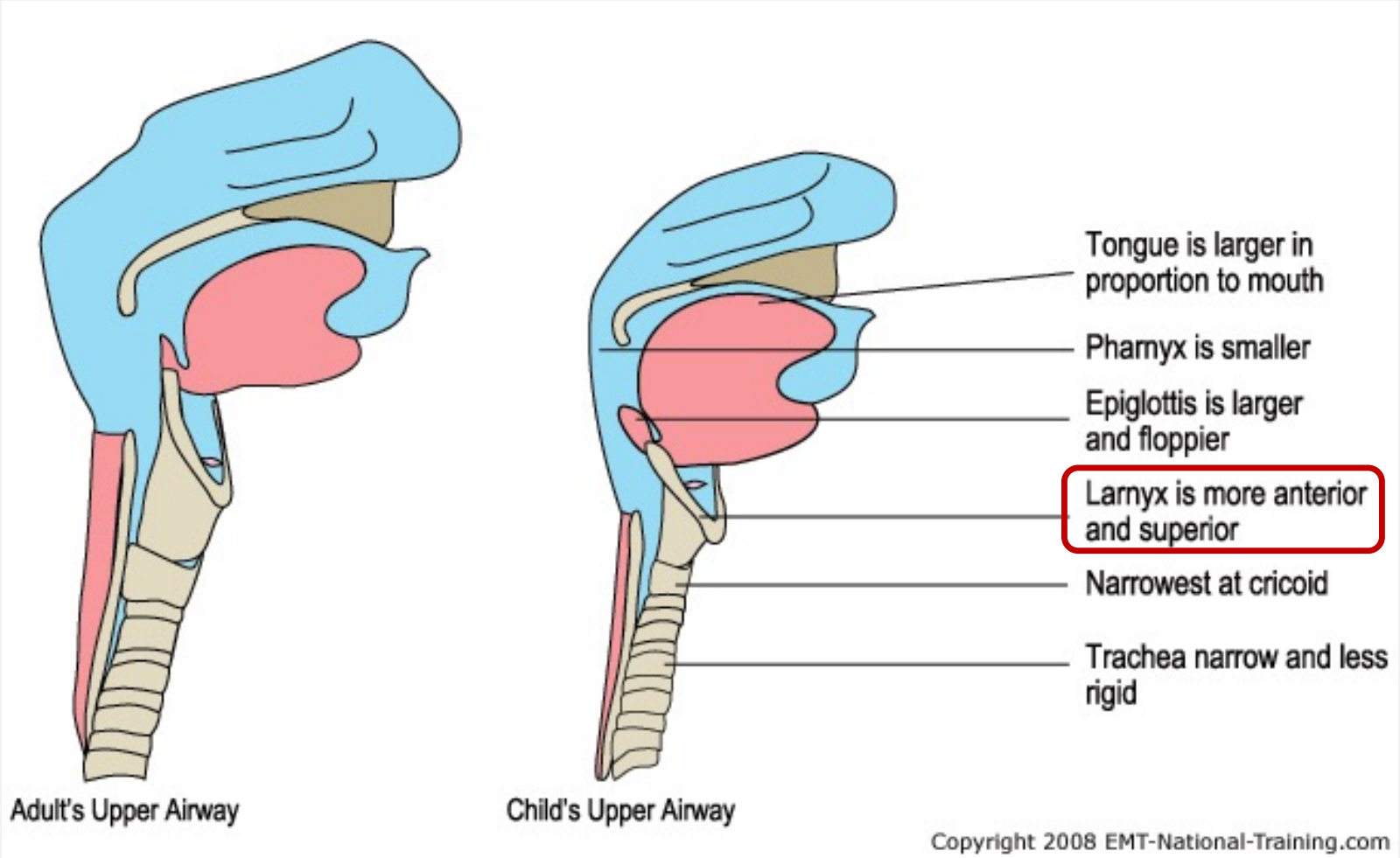


PROBLEM: AIRWAY

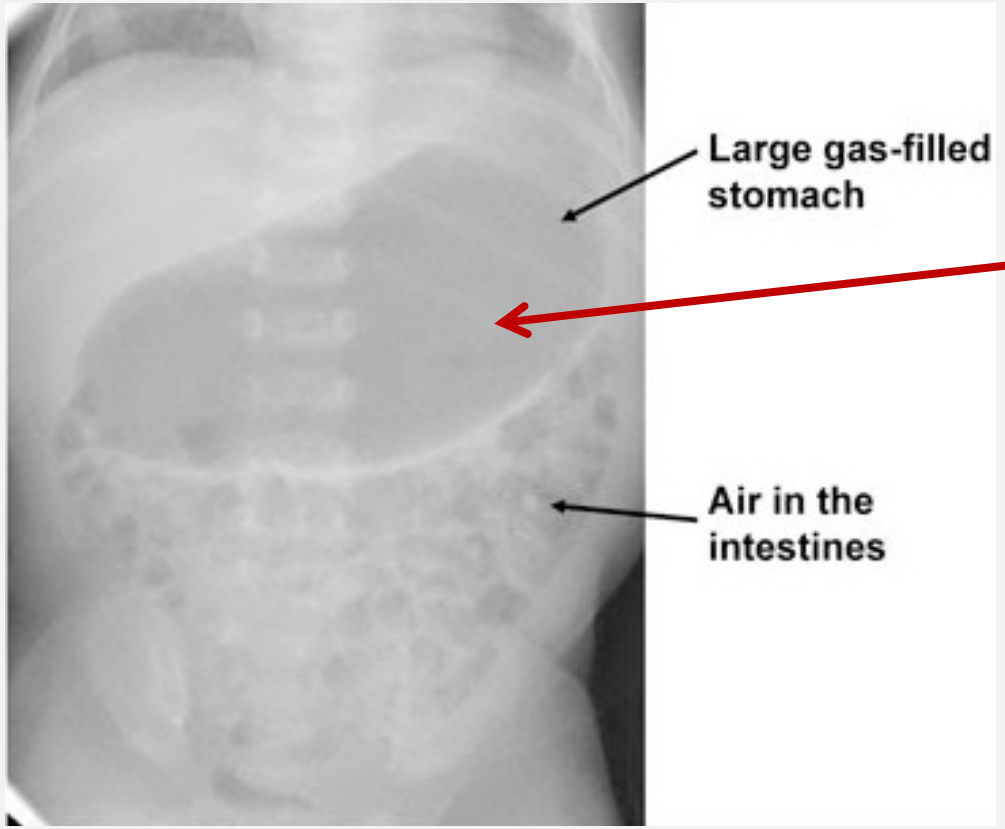
- Intubation is indicated (earlier the better)
  - NO CUFFS!
- Regardless of age, *RSI* is indicated
- ALL drugs have been accepted for use in general practice
  - Benzos alone are useless

DON'T BE A WUSS!

PROBLEM: AIRWAY



PROBLEM: AIRWAY



ALWAYS get the air out!

OTHER PITFALLS IN INFANT STABILIZATION

- You must identify and correct *hypoglycemia* at the bedside
- *Normothermia* must be maintained
- Something *ALWAYS* goes wrong with the airway!

ILLUSTRATIVE CASES

OVERVIEW

- Cases
  - Shock
  - Cyanosis
  - Seizures
  - Lethargy

CASE ONE:
SHOCK TO THE SYSTEM

CASE: SHOCK TO THE SYSTEM

- A *1 week old* presents with a *1 day history* of poor feeding and apparent respiratory distress
- *Afebrile, HR 180, RR 40, BP 50/30, OSAT 90% in RA*
- Cool extremities, *capillary refill 6 seconds*
- *Grunting* with retractions, poor air entry
- No murmur

CASE DISCUSSION

- This infant is in *uncompensated shock*
- *Unclear etiology* at this point
  - Septic ?
  - Hypovolemic?
  - Cardiogenic?
- Accompanying *respiratory failure*

WHERE SHOULD THERAPY BEGIN?

- Airway
  - OK for now
- Breathing
  - Acyanotic
  - *Profound work of breathing*
- Circulation
  - *Unacceptable*

CASE PROGRESSION: CIRCULATION

- Could this be distributive or septic shock?
  - There is *no history of volume loss*
- After blood cultures obtained, *antibiotics are indicated*
  - Cefotaxime
  - Ampicillin (Listeria)

CASE PROGRESSION: CIRCULATION

- Undifferentiated neonatal shock
- *Volume is indicated*
  - 10 - 20 cc/kg NS push
  - Repeat up to 60 cc/kg
- *Obtain CXR to check heart size* as a rough estimate of vascular status

CASE PROGRESSION: CIRCULATION

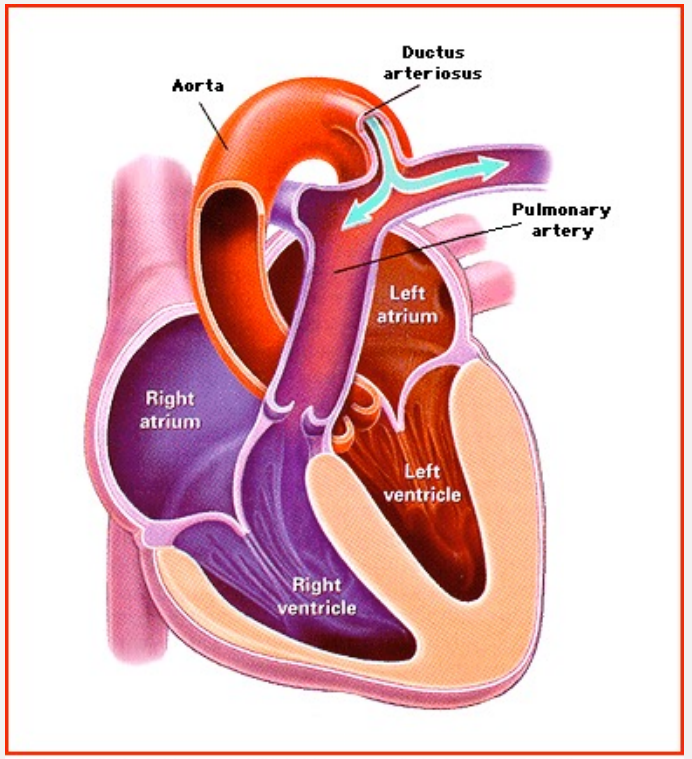
- Given 60 cc/kg NS
- *Respiratory distress increases*
- *Hepatomegaly*
- CXR

CASE DECISION POINT – INTUBATION?

- Facts
  - Most young infant intubations should have been *performed sooner*
  - Window to *acidosis* development
  - RSI in small infants necessitates standardized drug protocols
    - *Benzos alone are useless*
    - *ALWAYS use paralytics*
  - There is always excessive gastric air – impairs tidal volume – *suctioning is indicated*

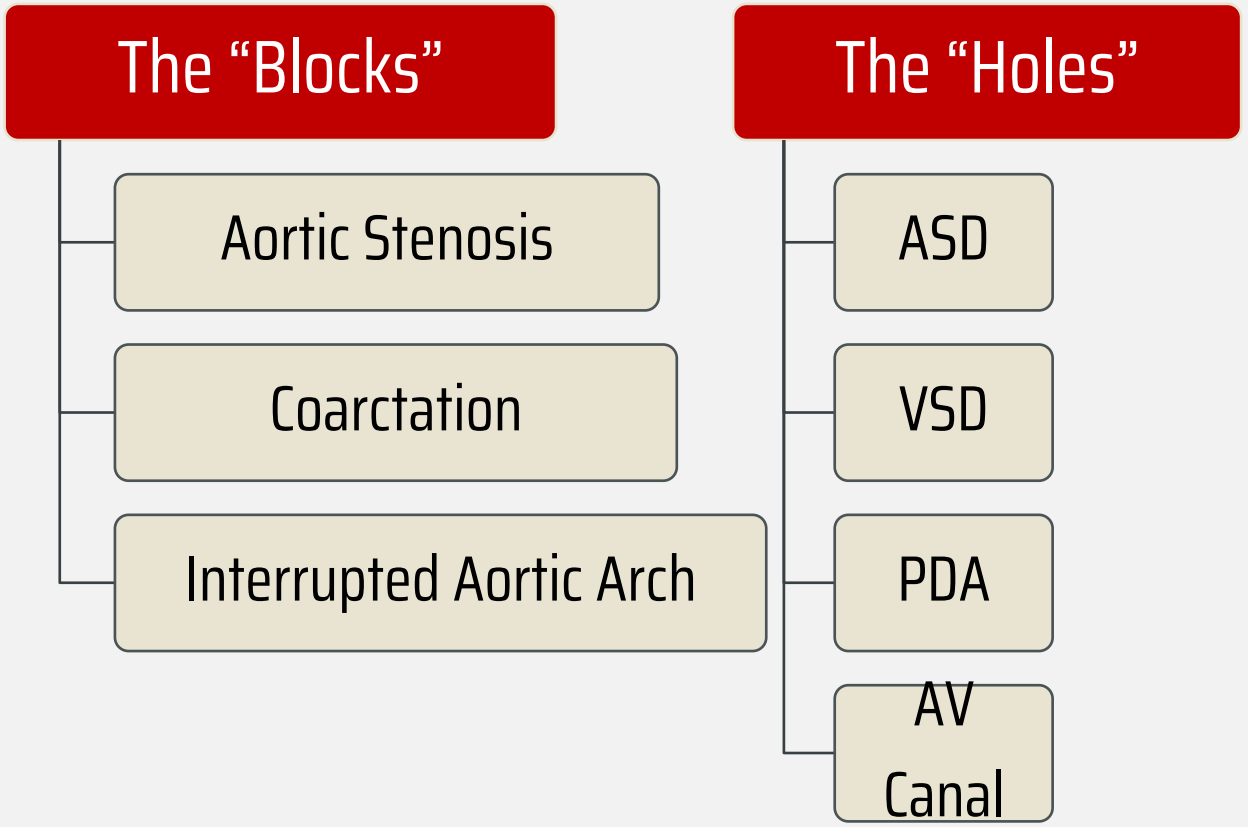
CASE PROGRESSION: CIRCULATION

- Could this be congenital heart disease?
- *NOT the cyanotic variety*
  - Present early (ie first few days)
  - Would fail hyperoxia challenge
- Most likely a ductal dependent lesion



Patent ductus arteriosus With a patent ductus arteriosus there is a communication between the aorta and the pulmonary artery. Some of the blood from the aorta crosses the patent ductus arteriosus and flows into the pulmonary artery (arrows), resulting in a left-to-right shunt. (With permission from Brickner, ME, Hillis, LD, Lange, RE. N Engl J Med 2000; 342:334. Copyright © 2000 Massachusetts Medical Society. All rights reserved).

PEDIATRIC CHF IN A NUTSHELL



PEDIATRIC CHF IN A NUTSHELL

The "Blocks"

- Ductus dependent
- Present EARLY in CHF (less than 2 weeks)

The "Holes"

- Failure occurs when LV pressures are high enough to shunt blood to the PA
- Present in CHF generally after a few weeks

CASE RESOLUTION

- The child is in CHF
- *Given Prostaglandin E1*
- Perfusion normalizes
- *Echocardiogram demonstrates Coarctation of the Aorta with ductal dependent perfusion*
- Repaired surgically

TAKE HOME MESSAGE

- Infants < 2 weeks presenting in shock deserve consideration of:
  - *Volume loss*
  - *Sepsis*
  - *Ductal dependent lesions*

- *Prostaglandins* should always be considered

SHOCK MADE SIMPLE

Easy Steps

EASY STEPS

Get Pretreatment Cultures (Blood, Urine, CSF Later)

Give Antibiotics

Ampicillin	Ceftriaxone

EASY STEPS

Administer *20 cc/kg NS RAPIDLY*

If *ABC's worsen, immediate CXR* (could be cardiogenic)

If cardiac silhouette is enlarged, *consider Prostaglandin PGE1*	If cardiac silhouette is *equivocal*, room for more fluids

EASY STEPS

If vitals *improve* administer another 40 cc/kg NS

If vitals stabilize, relax, consider volume loss or distributive causes

- Consider sepsis, draw blood cultures, administer antibiotics

IF CONSIDERING A HYPOVOLEMIC ETIOLOGY,
IT WOULD BE NICE TO HAVE A CONSISTENT HISTORY
(vomiting, diarrhea, poor intake)

EASY STEPS

If vitals do not improve, begin *pressors*

DON"T forget pallid shock – *need RBC not crystalloid*

Volume loading would be harmful in anemic shock

NOTHING SEEMS TO WORK

HISTORY

An ALS Radio call is received, in midwinter, announcing the transport of a 3 week old AA male in *respiratory distress*

He is described as in marked respiratory distress, mildly cyanotic, with good perfusion

Wheezing is heard and, as per protocol, a *nebulized albuterol* treatment is administered during the 10-minute transport

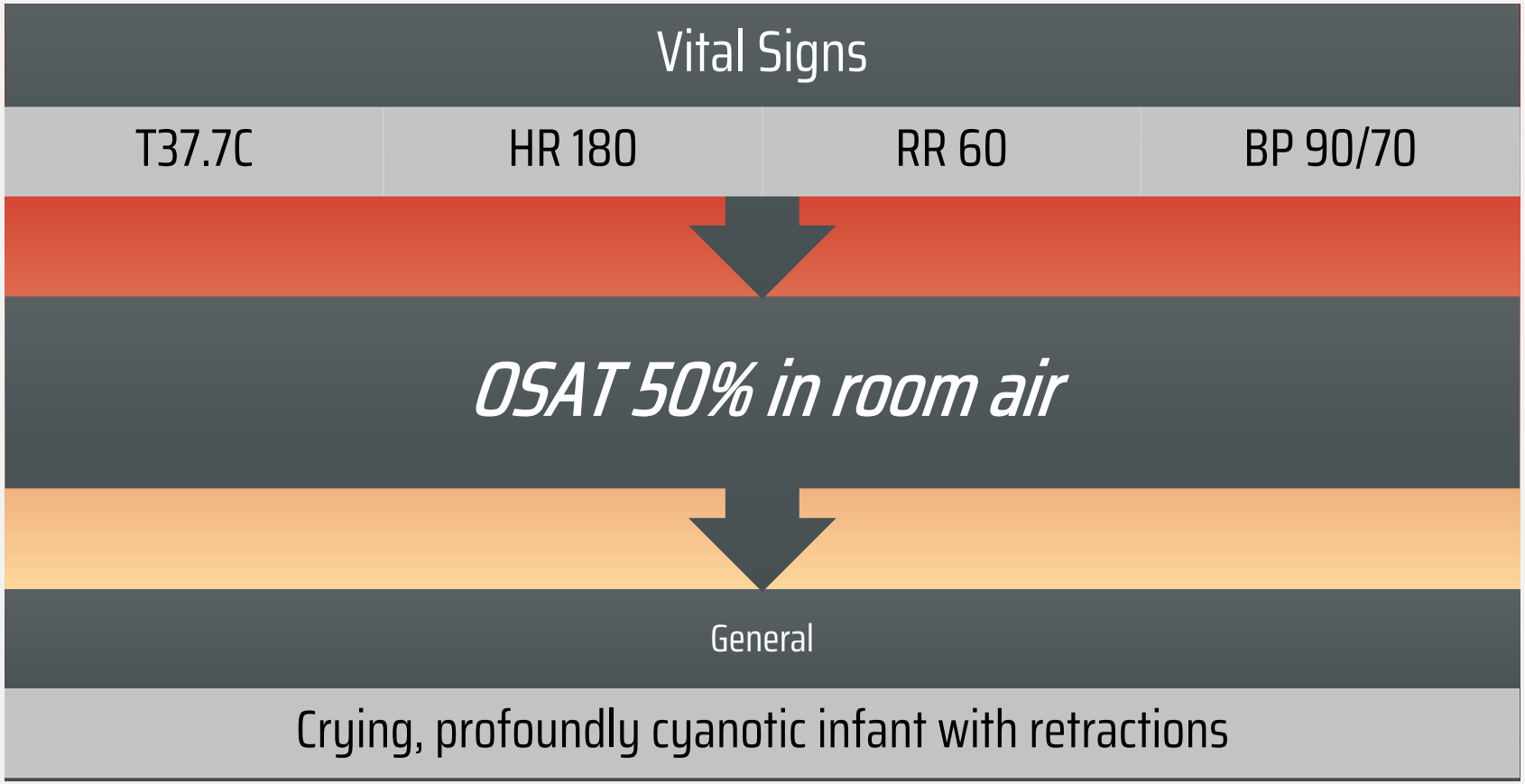
HISTORY

History obtained from the mom on arrival reveals a normal prenatal and birth history

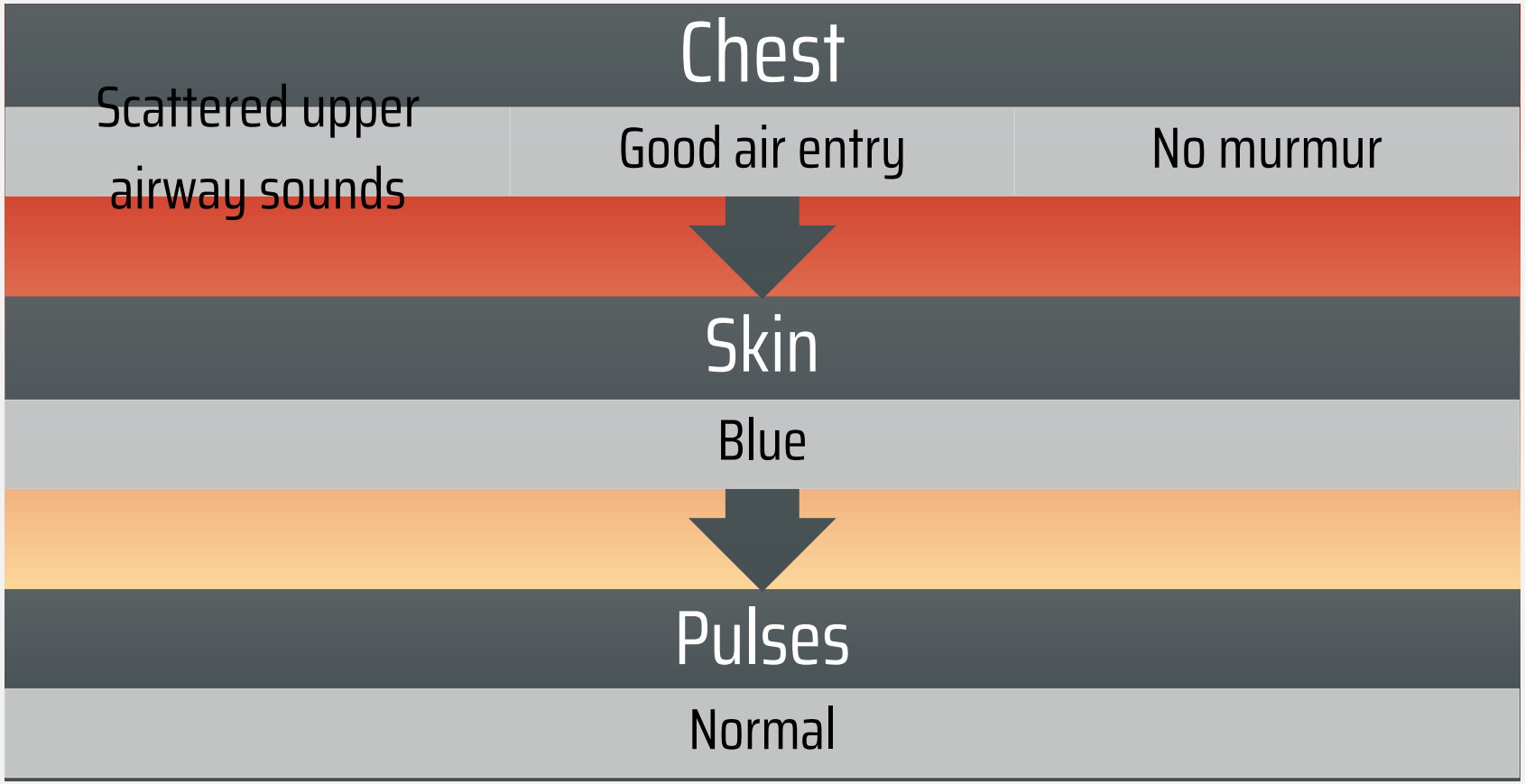
She thinks he has *"Sickle Trouble"*

Well all day

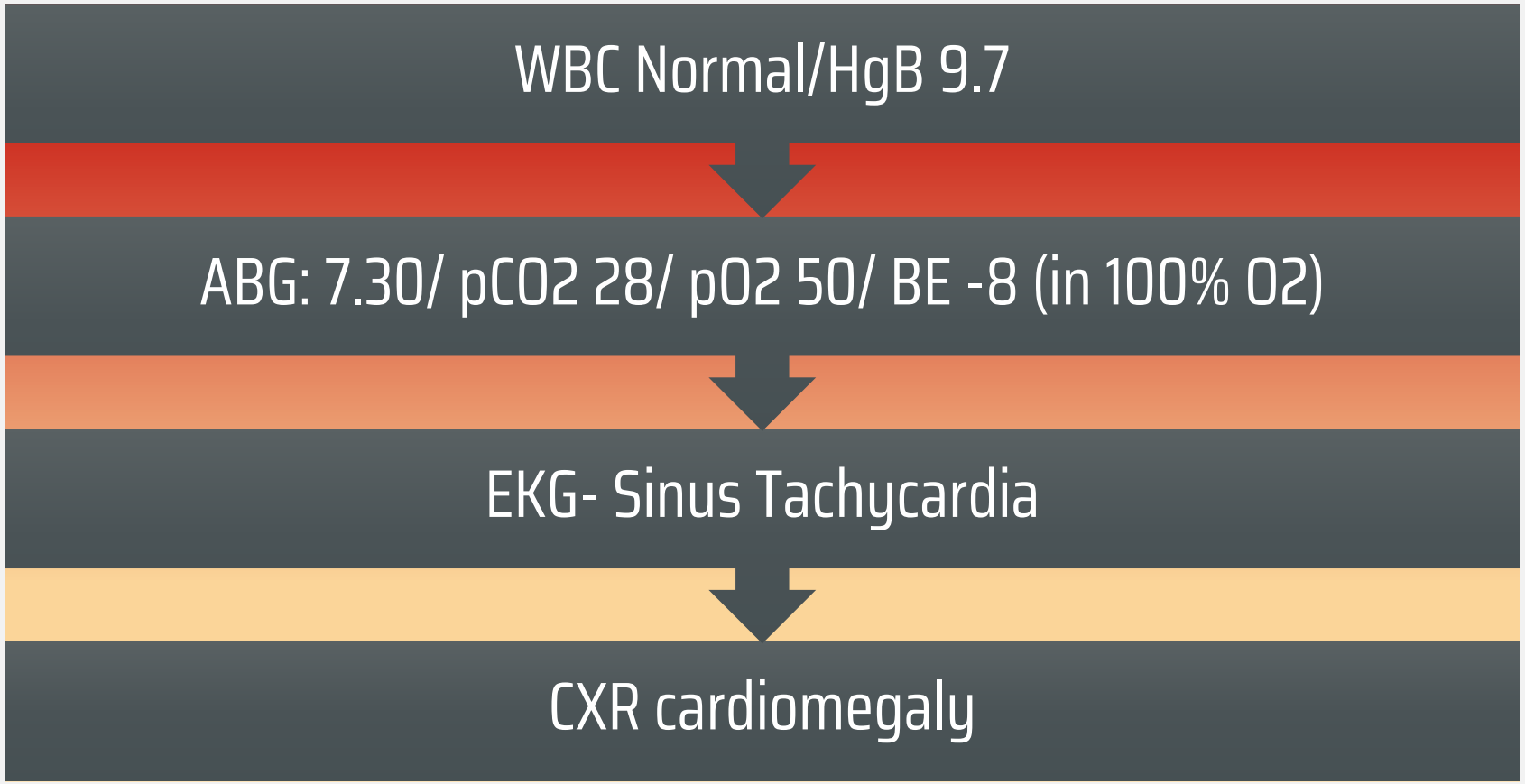
PHYSICAL


Vital Signs
T37.7C
HR 180
RR 60
BP 90/70
OSAT 50% in room air
General
Crying, profoundly cyanotic infant with retractions

PHYSICAL


Chest
Scattered upper airway sounds
Good air entry
No murmur
Skin
Blue
Pulses
Normal

DATA


WBC Normal/HgB 9.7
ABG: 7.30/ pCO2 28/ pO2 50/ BE -8 (in 100% O2)
EKG- Sinus Tachycardia
CXR cardiomegaly

REAL TIME CASE PROGRESSION

- Interventions
  - Albuterol
  - 20 cc/kg NS
  - Antibiotics

NO IMPROVEMENT

REALITY BASED OUTCOME

- OSAT still 50% (on 100%)
- Still screaming
- Room getting smaller
- More people watching the case

CXR

NOT HELPFUL

TIME TO EARN YOUR MONEY

- IV Morphine 0.1 mg/kg
- Calms, respiratory rate decreases
- OSAT jumps to 98% (your heart rate drops below 200)

COMMON CYANOTIC CARDIAC LESIONS

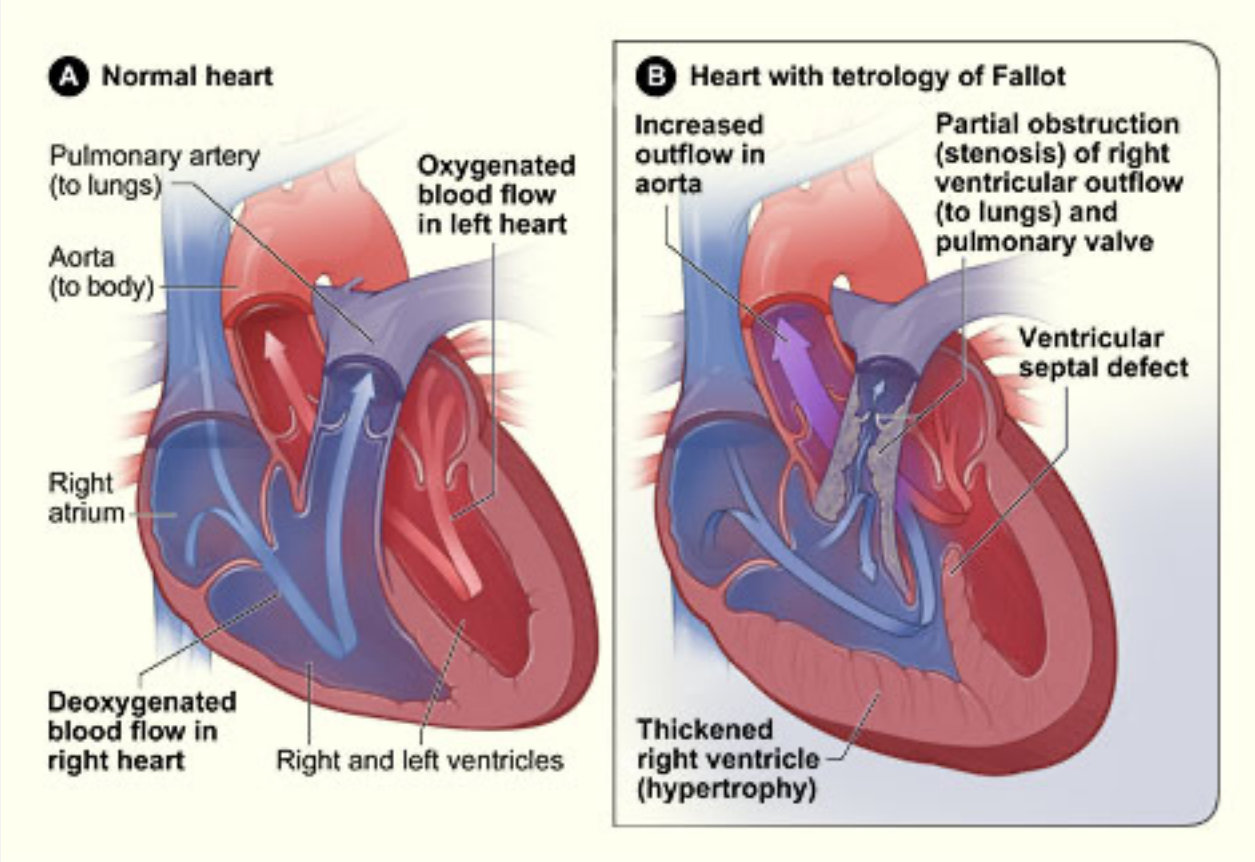
The Five T's

- Tetrology of Fallot
- Transposition of the great vessels
- Truncus arteriosus
- Tricuspid atresia
- TAPVR

CONGENITAL LESIONS USUALLY ASSOCIATED WITH CYANOSIS

Lesion	*Usual Time of Onset of Cyanosis*
Transposition of the Great Arteries	**Birth to First Week**
Total Anomalous Pulmonary Venous Return	**First Week**
Tricuspid Atresia	**Weeks 1-4**
Ebstein's Anomaly of the Tricuspid Valve	**First Week**
Tetrology of Fallot	**Weeks 1-12**
Severe Pulmonic Stenosis	**Weeks 1-4**

TETROLOGY


A Normal heart
Pulmonary artery (to lungs)
Aorta (to body)
Oxygenated blood flow in left heart
Right atrium
Deoxygenated blood flow in right heart
Right and left ventricles
B Heart with tetrology of Fallot
Increased outflow in aorta
Partial obstruction (stenosis) of right ventricular outflow (to lungs) and pulmonary valve
Ventricular septal defect
Thickened right ventricle (hypertrophy)

HYPOXEMIC ("TET") SPELLS

- Usually self limited (15-30 minutes)
- More common in the AM or after a nap
- May be self perpetuating

STEPWISE TREATMENT OF TET SPELLS

- Comfort; knee chest position; 100% O2
- Morphine 0.1 mg/kg
- IV fluid resuscitation
- IV Bicarbonate
- IV phenylephrine (increases SVR)
- IV propranolol

TAKE HOME MESSAGE

- The secret of mammalian oxygenation:
  - You *breathe* it (pulmonary)
  - You *pump* it (cardiac)
  - You *carry* it (hemoglobin)

- Hints
  - Use the *hyperoxia* test
  - OSATs in the mid 80s are often *methemoglobinemia*

CYANOSIS MADE SIMPLE

Easy Steps

EASY STEPS

Administer *supplemental oxygen*

If OSAT rises, most likely *pulmonary* disease

EASY STEPS

Administer supplemental oxygen

- If OSAT *does not rise consider Cyanotic Heart Disease OR Methemoglobinemia*
- On 100% O2 if *pO2 is high and OSAT is low = Methemoglobinemia*
- you can dissolve it but *NOT* carry it

EASY STEPS

Administer supplemental oxygen

If OSAT does not rise consider Cyanotic Heart Disease OR Methemoglobinemia

- *On 100% O2 if pO2 is low and OSAT is low*, consider cyanotic heart disease

HYPEROXIA TEST

TABLE 4–3. EXAMPLES OF HYPEROXIA TEST RESULTS (OXYGEN CHALLENGE TEST)

	FiO_2 = 0.21 PaO_2 (% saturation)		FiO_2 = 1.00 PaO_2 (% saturation)	$PaCO_2$
Normal	70 (95)		>200 (100)	35
Pulmonary disease	50 (85)		>150 (100)	50
Neurologic disease	50 (85)		>150 (100)	50
Methemoglobinemia	70 (85)		>200 (85)	35
Cardiac disease				
Separate circulation[a]	<40 (<75)		<50 (<85)	35
Restricted PBF[b]	<40 (<75)		<50 (<85)	35
Complete mixing without restricted PBF[c]	50 (85)		<150 (<100)	35
Persistent pulmonary hypertension	Preductal	Postductal		
PFO (no R-to-L shunt)	70 (95)	<40 (<75)	Variable	35-50
PFO (R-to-L shunt)	<40 (<75)	<40 (<75)	Variable	35-50

STOP SHAKING PLEEZE!

HISTORY

A *2 week old male* infant is transported to your facility by ALS for *seizures*

Well that morning, the mother fed the child and placed him down for his usual nap

When she went into his room to check on him, he was drooling, stiff, jerking, and blue

HISTORY

Twitching and somewhat “post ictal” at times

During transport, IV attempts failed, and *rectal Valium* was ordered

After a 10 minute transfer, the child arrives in the ED and you begin your care

PHYSICAL EXAMINATION

Vitals

- T 37C
- HR 180
- RR 24
- BP 90/70

General

- *Seizing*, with good capillary refill

HEENT

- Fontanel flat/ atraumatic
- Pupils mid position and reactive (sluggish)
- Fundi not seen
- Pharynx with

PHYSICAL EXAMINATION

Neck

- No adenopathy

Chest

- Scattered upper airway sounds
- Good air entry
- PMI normal/ no murmur

PHYSICAL EXAMINATION

Abdomen

- Distended, but soft
- No masses
- Soft guaiac neg stool

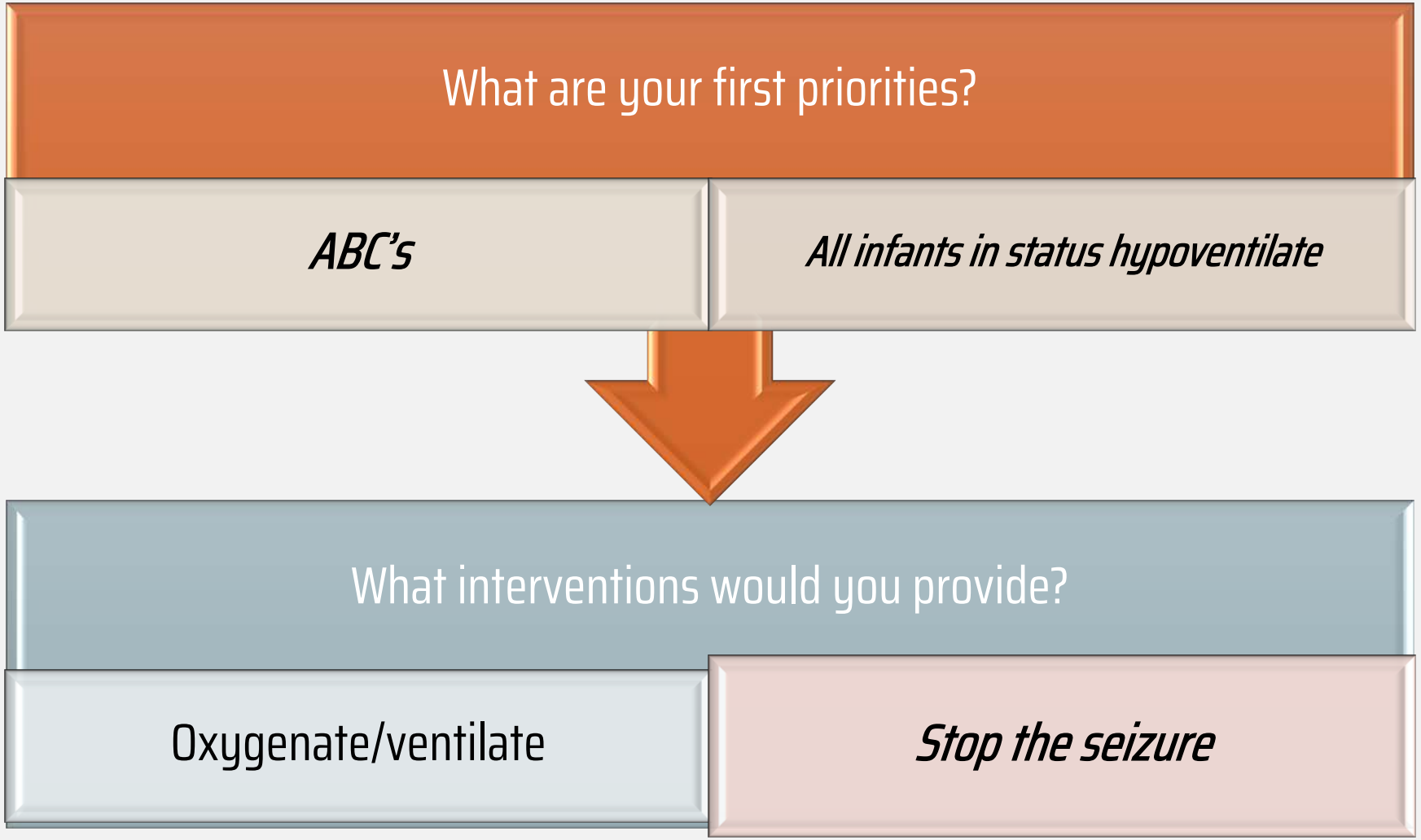
Pulses

- Normal

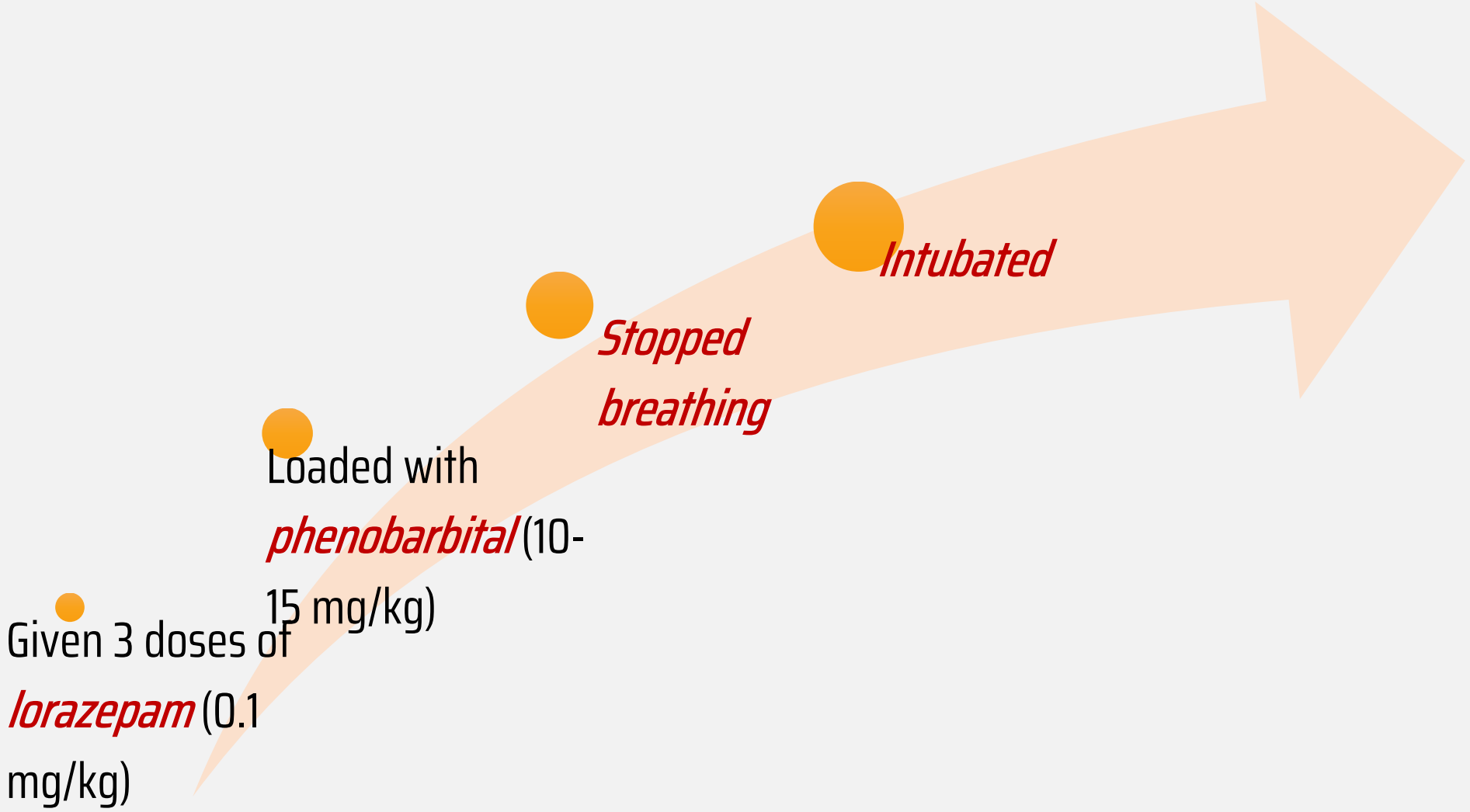
Extremities

- *Stiff*

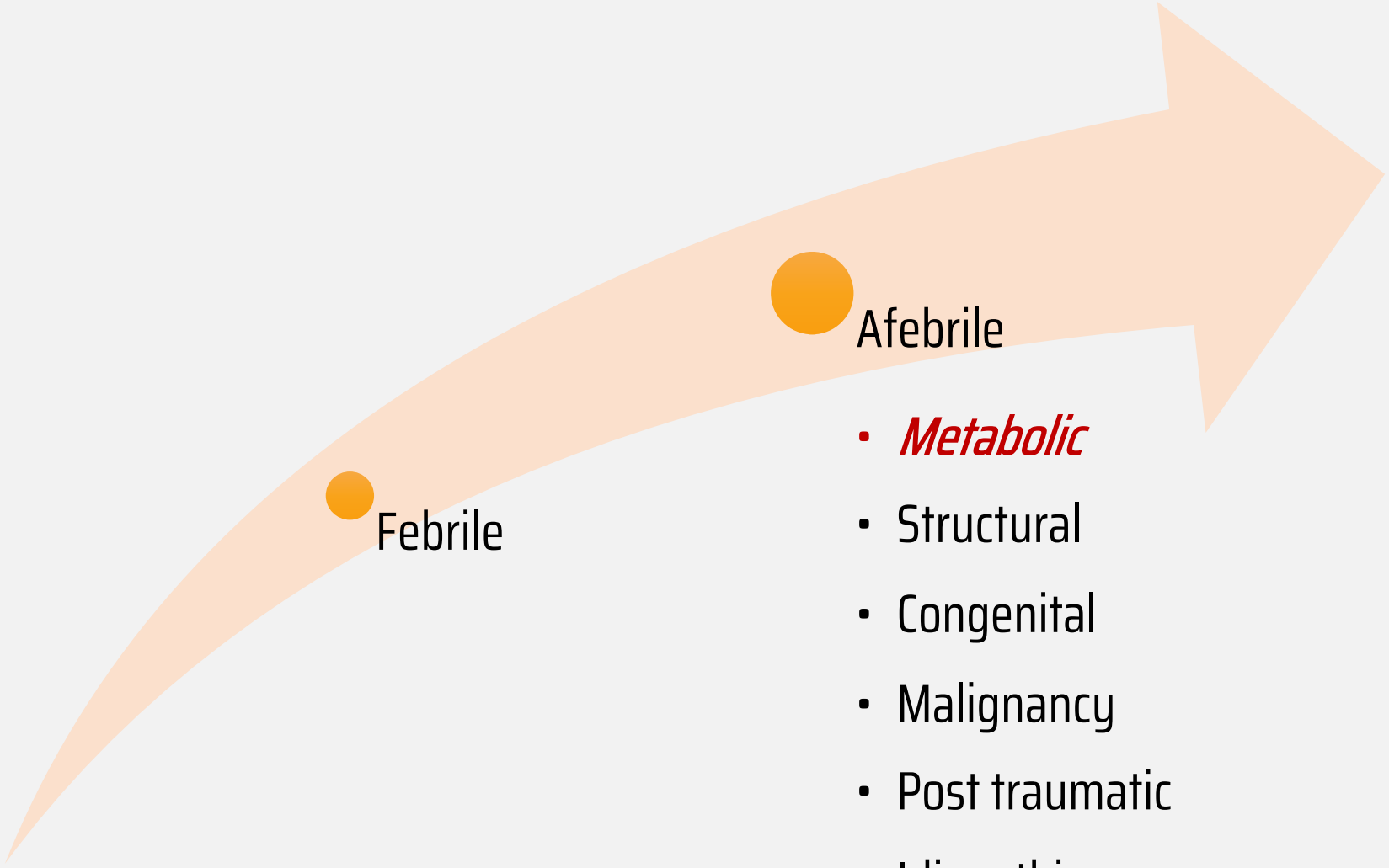
DECISION PROCESS



REAL TIME CASE PROGRESSION



COMMON ETIOLOGIES OF INFANTILE SEIZURES



INVESTIGATIVE PRIORITIES FOR NEONATAL SEIZURES

- *Infection* (CBC, Cultures, Spinal Tap)
- Dynamic *mass* effect (CT/management of increased ICP)
- *Electrolytes/Calcium/Phosphorus*
- Toxins

LAB RESULTS

- Chemstrip 120
- CT normal
- CBC normal
- *Sodium 112*
- *Chloride 87*
- *Potassium 5.5*
- *Bicarb 30*
- *Glucose 120*
- CSF Normal

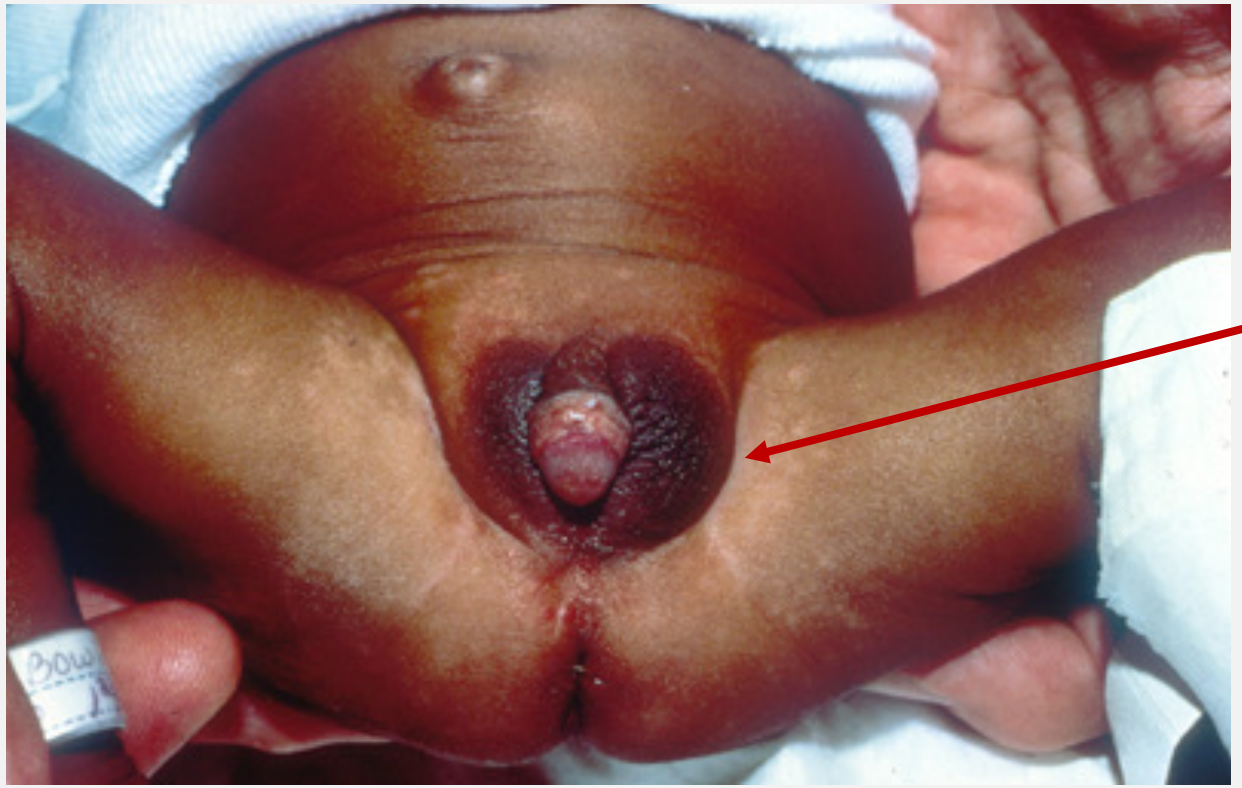
ETIOLOGIES OF HYPONATREMIA

Dilutional	
Water intoxication (formula mishaps)	SIADH (CNS/Pulmonary)

Salt Depleted		
Renal (Diuretics, adrenal disorders)	Cutaneous (CF)	Stool (Enteropathy)

Where does our patient fit?

LOOK OUT BELOW



Ambiguous genitalia

CONGENITAL ADRENAL HYPERPLASIA

- Autosomal recessive defects in *cortisol* synthesis
- Increased ACTH elevates blocked precursors (genital anomalies)
- Worst forms are *salt wasters* (21 OH deficiency)

TREATMENT OF HYPONATREMIA

- Most seizures *resolve* pre-transport
- If necessary, may administer 3% Saline
  - 4ml/kg over 10 minutes, up to 10ml/kg over 1 hour

TAKE HOME MESSAGE

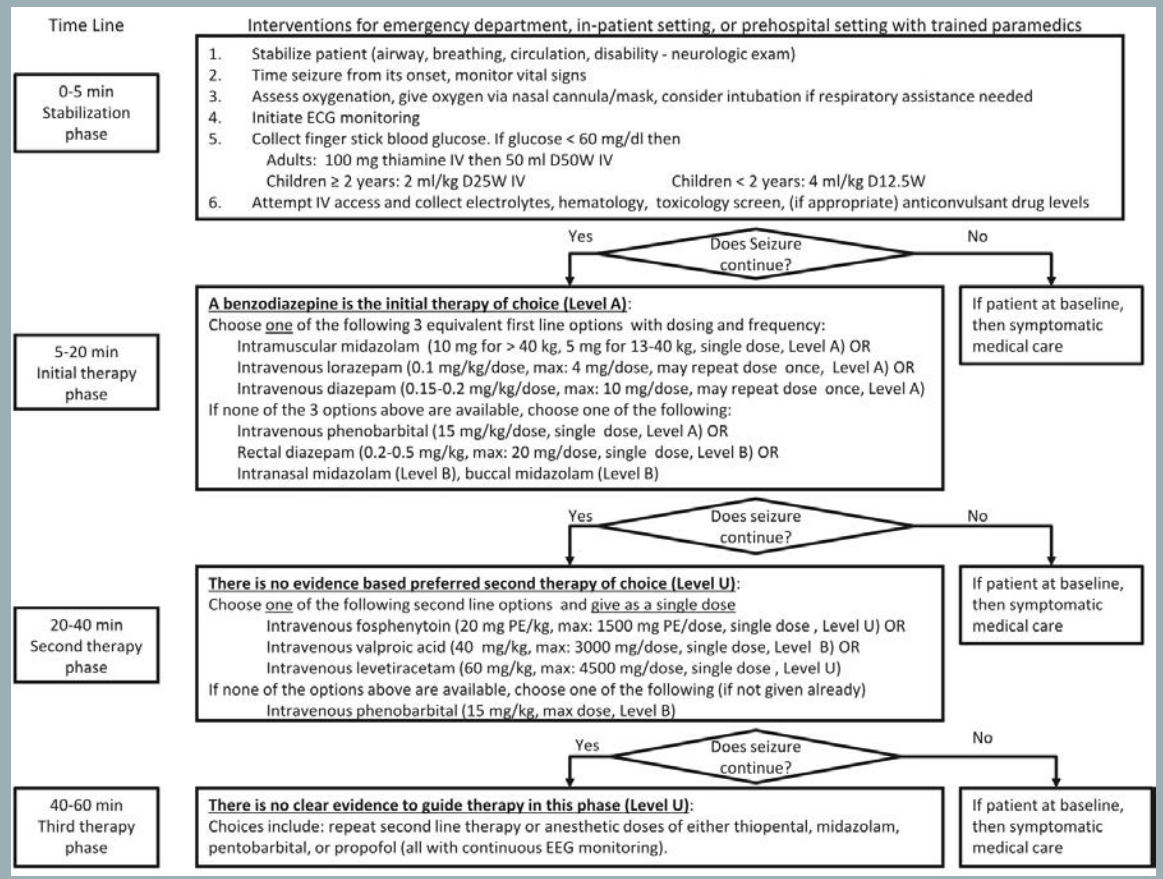
- Always *remove* the diaper!
  - Hernias
  - Ambiguity
  - Femoral Pulses
  - Rectal/Anal anomalies

SEIZURES MADE SIMPLE

EPILEPSY CURRENTS

American Epilepsy Society Guideline

Evidence-Based Guideline: Treatment of Convulsive Status Epilepticus in Children and Adults: Report of the Guideline Committee of the American Epilepsy Society



Epilepsy Currents
Vol 16: 48-61
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STABILIZATION PHASE

Time Line	Interventions for emergency department, in-patient setting, or prehospital setting with trained paramedics
0-5 min Stabilization phase	1. Stabilize patient (airway, breathing, circulation, disability - neurologic exam) 2. Time seizure from its onset, monitor vital signs 3. Assess oxygenation, give oxygen via nasal cannula/mask, consider intubation if respiratory assistance needed 4. Initiate ECG monitoring 5. Collect finger stick blood glucose. If glucose < 60 mg/dl then Adults: 100 mg thiamine IV then 50 ml D50W IV Children ≥ 2 years: 2 ml/kg D25W IV Children < 2 years: 4 ml/kg D12.5W 6. Attempt IV access and collect electrolytes, hematology, toxicology screen, (if appropriate) anticonvulsant drug levels

A Airway

B Breathing

C Circulation

D Dextrose

INITIAL THERAPY PHASE

5-20 min
Initial therapy phase

A benzodiazepine is the initial therapy of choice (Level A):
Choose one of the following 3 equivalent first line options with dosing and frequency:
- Intramuscular midazolam (10 mg for > 40 kg, 5 mg for 13-40 kg, single dose, Level A) OR
- Intravenous lorazepam (0.1 mg/kg/dose, max: 4 mg/dose, may repeat dose once, Level A) OR
- Intravenous diazepam (0.15-0.2 mg/kg/dose, max: 10 mg/dose, may repeat dose once, Level A)

If none of the 3 options above are available, choose one of the following:
- Intravenous phenobarbital (15 mg/kg/dose, single dose, Level A) OR
- Rectal diazepam (0.2-0.5 mg/kg, max: 20 mg/dose, single dose, Level B) OR
- Intranasal midazolam (Level B), buccal midazolam (Level B)

Benzodiazepines → Barbiturates

SECOND THERAPY PHASE

20-40 min
Second therapy phase

There is no evidence based preferred second therapy of choice (Level U):
Choose one of the following second line options and give as a single dose
- Intravenous fosphenytoin (20 mg PE/kg, max: 1500 mg PE/dose, single dose , Level U) OR
- Intravenous valproic acid (40 mg/kg, max: 3000 mg/dose, single dose, Level B) OR
- Intravenous levetiracetam (60 mg/kg, max: 4500 mg/dose, single dose , Level U)

If none of the options above are available, choose one of the following (if not given already)
- Intravenous phenobarbital (15 mg/kg, max dose, Level B)

Fosphenytoin → Valproate → Levetiracetam

THIRD THERAPY PHASE

40-60 min Third therapy phase	**There is no clear evidence to guide therapy in this phase (Level U)**: Choices include: repeat second line therapy or anesthetic doses of either thiopental, midazolam, pentobarbital, or propofol (all with continuous EEG monitoring).

REQUIRE CONTINUOUS EEG MONITORING

THE LETHARGIC INFANT OR CHILD

Easy Steps

EASY STEPS

- Check and fix the *glucose* if necessary
- Administer *Narcan* (unless the 3 year old is an opioid addict)
- Expedite *imaging* to rule out a mass effect (bleed, tumor)
- If meningitis is possible, draw a blood culture and administer *Ceftriaxone* (you've got time to do the tap)

THESE ARE NON NEGOTIABLE ACTIONS

EASY STEPS

- Run through the following mnemonic:
  - A Alcohol (level)
  - E Epilepsy
  - I Insulin (Munchausens By Proxy)
  - *I* *Intussusception (vomiting/irritability)*
  - O Overdose
  - U Uremia (labs)
  - T Trauma
  - I Infections
  - P Psychiatric
  - S Shock

FINAL POINTS

THE SHOCKY INFANT: KEY CONCEPTS

- The majority of hypotensive pediatric patients respond to
  - Early intubation
  - Volume resuscitation
  - Antibiotics
  - Pressors if necessary

THE SHOCKY INFANT: KEY CONCEPTS

- If volume resuscitation worsens the clinical status of an infant, *consider cardiogenic etiologies*
- CHF within the first 2 weeks may benefit from *prostaglandins* (ductal dependent lesions)
- CHF after 30 days is often due to *some form of septal defect* (ASD, VSD, AV Canal, PDA) and will benefit from diuretics, etc

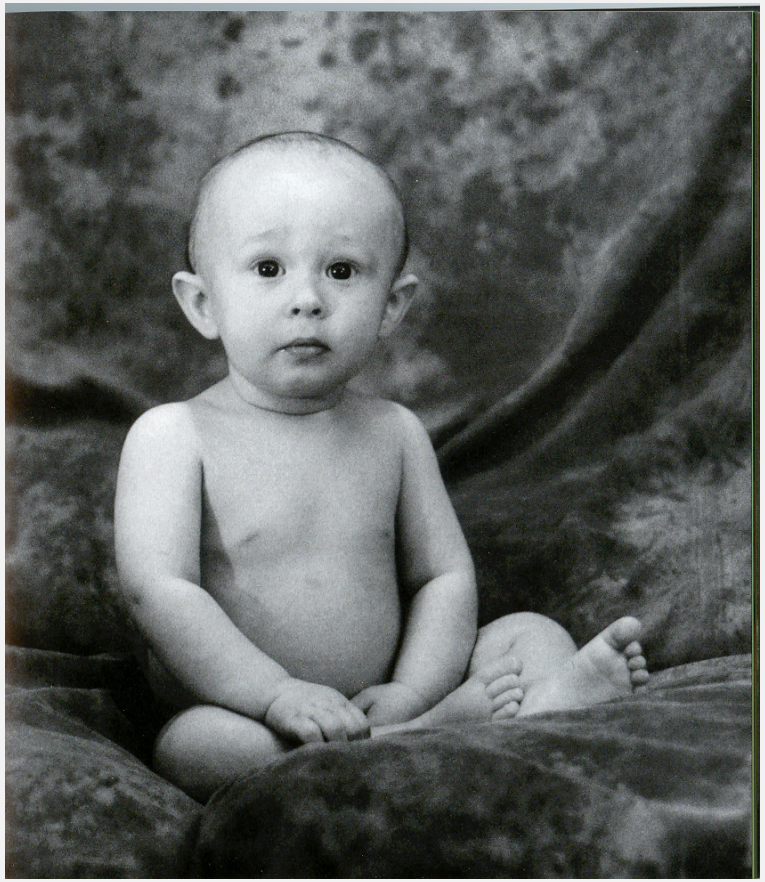
THE CYANOTIC INFANT: KEY CONCEPTS

- The *hyperoxia test* provides valuable clues to the etiology of cyanosis
  - Responsive to supplemental O2 = pulmonary
  - Low SATs + High pO2 = methemoglobinemia
  - Low SATs + Low pO2 = cyanotic heart disease

THE INFANT IN STATUS: KEY CONCEPTS

- ALL children in status epilepticus hypoventilate
- Standard anti – epileptic drug protocols are published
- Intubation DOES NOT = DEFEAT!
- More resistant forms of status – consider metabolic causes or structural issues

THANKS!



Emergency Medicine for Rural and Indigenous Communities Conference

September 15th - 17th, 2022

End of Presentation

Questions?

FRONT LINE INDIGENOUS PARTNERSHIP

HARVARD HUMANITARIAN INITIATIVE

Mass General Brigham