Rocky Mountain Hospital for Children

At Presbyterian/St. Luke's

HealthONE

Outreach Education Program

Presents

Pediatric Emergency Assessments and Intervention

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Updated 3.2020

EPIDEMIOLOGY OF COMMON PEDIATRIC INJURIES AND EMERGENCIES LEADING TO CARDIAC ARREST

- 1 Month – 1 Year of age: SIDS
- 1 Year – Young Adulthood: Trauma
- Other Causes:
  - Submersion
  - Choking
  - Pneumonia
  - Asphyxia
  - Poisoning
  - Severe Asthma
  - Sepsis

Pediatric Differences

- Children may present with subtle signs or symptoms of serious injury

Anatomic Differences		Clinical Correlation
Proportionally larger head	→	Higher frequency of head trauma
Poorly protected abdominal organs	→	Higher risk of abdominal bleeding
Smaller diameter of the airway	→	Increased Risk of Airway Obstruction

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EARLY CHILDHOOD DEVELOPMENT MILESTONES

The first four years of a child's life are the most important period of development physically, emotionally, cognitively, socially and morally. This is a guide to what you might expect in their first four years – often called developmental 'milestones'.

NOTE **EVERY CHILD DEVELOPS DIFFERENTLY**

3 Months

- Turns head toward direction of sound
- Recognizes familiar faces and smiles back
- Follows moving objects
- Watches faces with interest
- Raises head and chest while lying on stomach
- Brings hand to mouth
- Takes swipes at dangling object with hands
- Begins to babble and imitate some sounds

6 Months

- Responds to other people's emotions
- Enjoys social plays/games (especially peek-a-boo)
- Struggles for out of reach objects
  Uses voice to express pleasure and displeasure
- Interested in mirror images
- Responds to their own name
- Babbles chain of sounds
  Rolls both ways (front to back, back to front)
- Sits with, and then without support on hands

1 Year

- Pulls up to stand, Walks holding onto furniture
- Tries to imitate during play (like winking when you wink or clapping when you clap)
- Explores objects; finds hidden objects and begins to use objects correctly (drinking from cup, brushing hair, dialing phone, listening to receiver)
- Uses simple gestures like shaking head to say 'NO' or waving to say 'BYE BYE'
- May speak single words like "Mama" and "Dada"
- Cries when Mother or Father leaves
- Babbles with inflection (changes in tone)
- Uses exclamations, such as "oh - oh!"
- Pokes index finger

2 Years

- Excited about the company of other children
- Begins to sort by shapes and colors; starts simple make-believe play
- Follows simple instructions; recognizes names of familiar people
- Walks without help; plays pretend (like talking on a toy phone)
- Points out at theobjects, when you name it (like toy or photo)
- Imitates behavior of others, especially adults and older children
- Uses 2-4 word sentences
- Repeats word overheard in conversation
- Pulls toys behind him/her while walking

3 Years

- Imitates adults and playmates
- Shows affection for playmates/friends
- Sorts objects by shape and colors; and matches objects to pictures
- Plays make-believe with dolls, animals and people (like feeding a doll)
- Uses pronouns (I, you, me) and sometimes plurals too (cars, dogs)
- Uses simple phrases or micro sentences to communicate with others
- Understands concept of 'mine' and 'his/hers'
- Expresses wide range of emotions
- Walks up and down stairs, alternating feet (one foot per stair step)
- Runs easily and pedals tricycle
- Starts to make friends

4 Years

- Follows three-step commands (like wash your hands, comb your hair)
- Draws circles and squares
- Speaks in sentences of 5-6 words; Speaks clear enough for outsiders to understand
- Names some colors; understands counting
- Shares and take turns with other children
- Knows the difference between boys and girls
- Enjoys humor (like laugh at silly faces or voices)
- Brushes his/her teeth by self
- Dresses and undresses without help except for shoelaces
- Pretends by role playing
- Knows opposite (hot/cold, big/small)

Disclaimer: These are general milestones. All children are different and some will do things faster or slower than others.If you have queries/concerns about your child's development, contact a pediatrician.

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Pediatric Assessment Tips

- Use systematic approach
- Get as much info as you can from across the room!
- Ask family to be a part of the assessment, infants, toddlers do really well with assessments while they are being held
- General impression, introduce yourself, gather up what you need while child assesses you.
- Use kid-friendly language. Get down on their level.
  - Use Simply Sayin' App for kid friendly medical language
- Take your time. "Assess" their teddy bear, listen to Mom's lungs first, let them use your stethoscope.
- Be honest!

Strategies for Caregiver

1-3 year olds

- Avoid separation from parents
- Allow time for toddler to get acquainted with you
- Attempt to perform assessments while the infant is being held
- Distract the infant with games
- Encourage parental presence and involvement during interventions

3-5 year olds

- Provide privacy
- Allow child to handle and play with medical equipment
- Use doll play to help prepare for treatments
- Bed-wetting in a previously toilet-trained toddler could be a sign of a urinary tract infection or other serious illness

Strategies for Caregiver

6-12 year olds

- Involve the child in care
- Explain procedures
- Provide time for interviewing away from parents
- Inquire about favorite activities
- Educate the child about illness and reinforce that illness is not their fault

13-18 year olds

- Active listening, open-ended questions, give choices when possible
- Remain non-judgmental; focus on obtaining health-related info and identifying risk factors
- Respect and maintain privacy
- Provide emotional support

Two Major Causes of Death in Pediatric Trauma

- Airway compromise
  - Cardiopulmonary failure in children is rare.
  - Arrest is the end result of deteriorating respiratory or circulatory failure.
- Unrecognized hemorrhage

Pediatric Considerations

- Children have limited capability for compensation
- Early recognition of respiratory distress and shock is important

Pediatric Vital Signs

	Respiratory	Pulse	Blood Pressure
Newborn	30-60	120-160	65/40
1-4 years	20-40	80-140	90-96/60-65
5-12 years	15-25	70-115	100-110/56-60
>12 years	12-20	60-100	<120/80

POLICY TITLE: Vital Signs in Children
DEPARTMENT(S) : ED
RMHC POLICY NUMBER: RMHC.PC.5307

Pediatric Assessment Triangle

- First tool of general assessment
- PAT triangle
  - General visual and auditory assessment
  - Completed in 30-60 seconds
  - Not a diagnostic tool
  - Facilitates immediate physiologic evaluation
- **Observation** is the most important assessment tool
  - Appearance -LOC
  - Respiratory rate and rhythm/ Work of breathing
  - Circulation/ Skin Color

TICLS

- **T**one - Is she moving? Good muscle tone? Or limp, listless, or flaccid?
- **I**nteractiveness – How alert? How distractible? Will she reach or grasp? Or is she uninterested in interacting?
- **C**onsolability
- **L**ook/ Gaze – Does she fix her gaze on a face? Or is there a glassy eyed stare?
- **S**peech/ Cry – Strong? Or weak, muffled, or hoarse?

Pediatric Trauma Score

Assessment Component	+2	+1	-1
Weight	>20kg	10-20kg	<10kg
Airway	Normal	Oral or nasal airway, oxygen	Intubated, cricothyroidotomy or tracheostomy
Systolic BP	>90mmHg; good peripheral pulses and perfusion	50-90mmHg; carotid/femoral pulses palpable	<50mmHg; weak or no pulses
Level of consciousness	Awake	Obtunded or any loss of consciousness	Coma, unresponsive
Fracture	None seen or suspected	Single, closed	Open or multiple
Cutaneous	None visible	Contusion, abrasion, laceration <7cm not through fascia	Tissue loss, any gunshot wound or stab wound through fascia

RMHC Approach

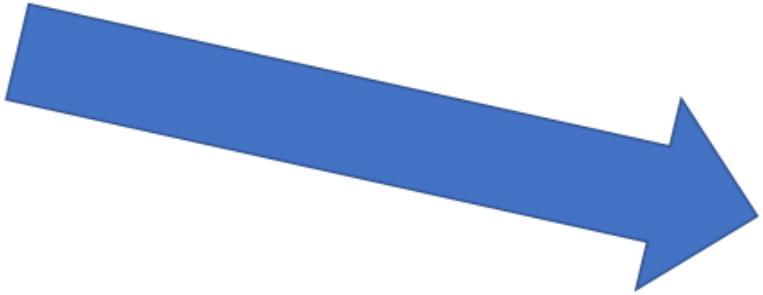
- Early Intervention and Effective Emergency Response
- Use of PEW Scores to identify patients at risk for critical events earlier.
- Increased Pediatric mock code drills.

HANDTEVY™
Pediatric Emergency Standards

EARLY INTEVENTION

- The best way to prevent arrest or to improve outcomes associated with cardiopulmonary arrest is to treat at-risk patients early.
- Signs and symptoms of deterioration can be very subtle in children.

Cliff of Doom



- What can we do to help them compensate?

Red Flags Of Respiratory Distress

- Early Signs
  - Tachypnea
  - Work of breathing
  - Changes in breath sounds
- Late Signs
  - Skin color changes
  - Apnea
  - Irregular respirations
  - Change in LOC
  - Bradycardia

Start PPV/CPAP EARLY

Red Flags Of Cardiovascular Collapse

- Early Signs
  - Tachycardia
  - Altered perfusion
    - Skin
    - Brain
    - Kidneys
- Late Signs
  - Decreased response to pain
  - Flaccid tone
  - Hypotension
  - Bradycardia

Pediatric Early Warning (PEW) Score

- A tool offering an objective means of assessing patient condition and trending changes in condition over time.
- Studies show that the use of pediatric early warning systems can help nurses identify deteriorating patients an average of 11 hours earlier than when using assessment alone (Akre, et al., 2010).

The Pediatric Early Warning(PEW) Score

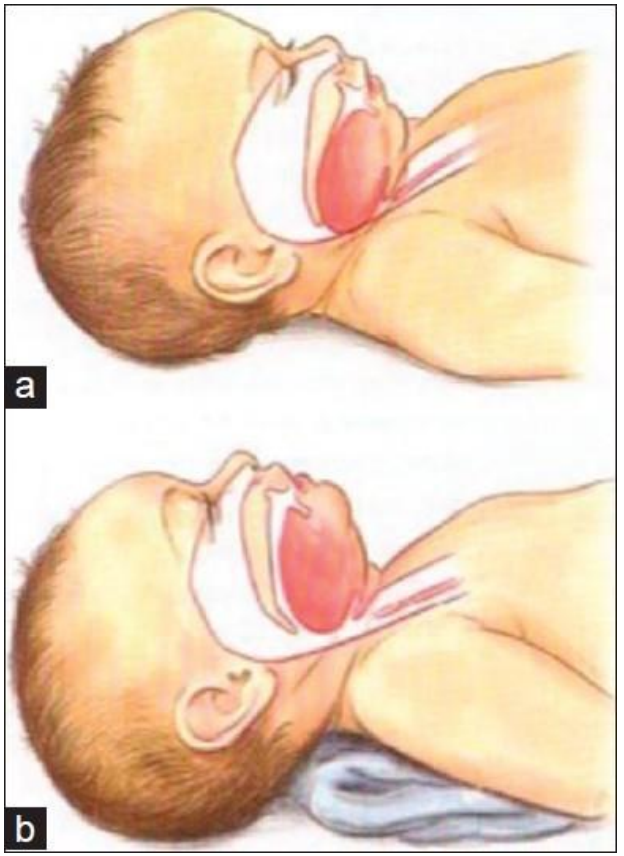
Components	0	1	2	3
Behavior	Playing/ Appropriate	Sleeping	Irritable	Lethargic/ confused OR Reduced response to pain
Cardiovascular	Pink or Capillary refill 1-2 seconds	Pale or capillary refill >2 seconds	Grey or capillary refill 4 seconds OR tachycardia of 20 above normal rate	Grey & Mottled or Cap refill >/= 5 seconds OR Tachycardia of 30 above normal rate OR Bradycardia
Respiratory	Within normal parameters, no retractions	> 10 above normal parameters, using accessory muscles OR oxygen 30+% FiO2 or 3+ L/min	> 20 above normal parameters, retractions OR 40+% FiO2 or 6+ L/min	5 below normal parameters with retractions, grunting OR 50+% FiO2 or 8+L/min
Score 2 extra for ¼ hourly nebulizers or persistent vomiting following surgery				

Primary Assessment
ABCDE – Hands-on

- Airway
- Breathing
- Circulation
- Disability
- Exposure

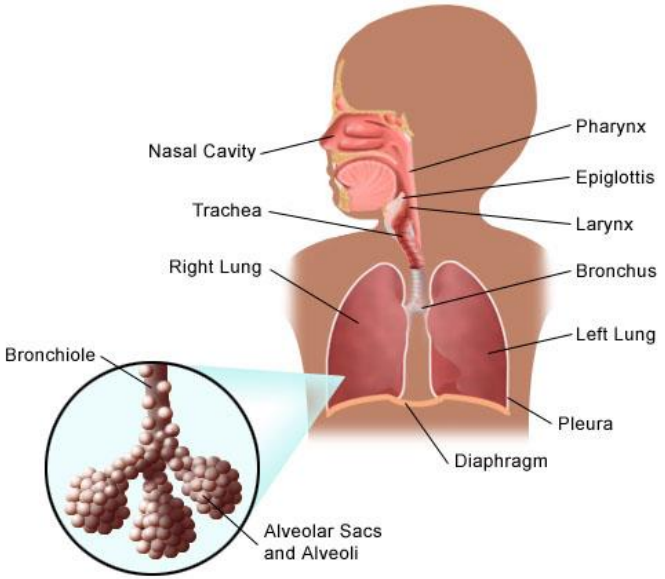
Airway

- Jaw thrust in a trauma patient
- Maintain neutral neck position
  - Neck Roll!
- Suction frequently
- Patency of nasal passages
- Determine if the airway is maintainable
  - If unable to open airway, consider obstruction.

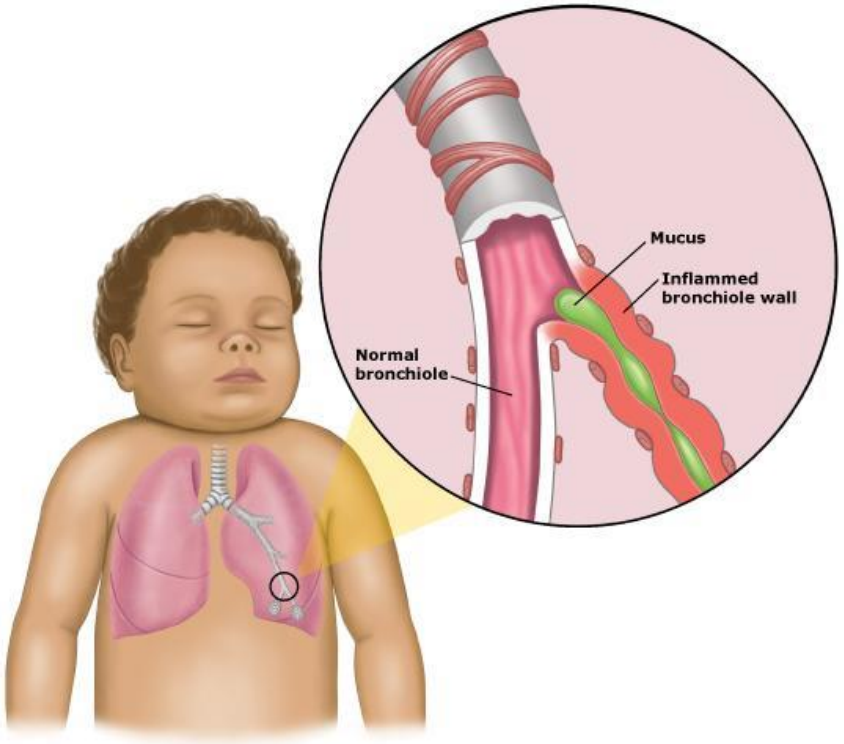


Airway

- Nasal passages are small in diameter & easily obstructed
- The tongue is the most common cause of airway obstruction
- Diameter trachea is 4mm in the infant, compared to 20mm in adults



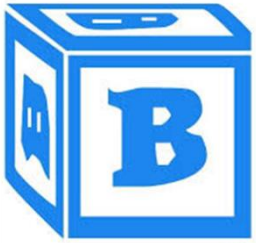
Airway



- Smooth muscle is more reactive (sensitive) to foreign bodies than adult's
  - Small amounts of swelling or mucous produce a severe reduction in the radius of the trachea, increasing airway resistance far more dramatically than in adults

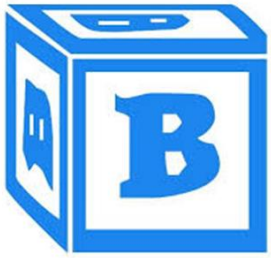
Suctioning- Death By Snot

- Question: Babies are obligate nose breathers until what age?
- Nasal suctioning- Most likely will need to add saline to thin out secretions
  - Bulb syringe
  - Nasal aspirator
  - Deep suctioning- vagal really easily

Breathing/Ventilation

- Until the age of 8, there are less alveoli and they are smaller
- Lung tissue more fragile
- Heart larger in proportion to chest
- Lung volume is decreased (5-7ml/kg tidal volume)
- Lungs are more stiff than adults.

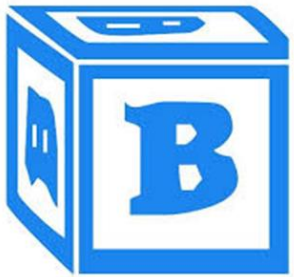


Breathing/Ventilation

- Rib cage is more compliant in children
  - Chest wall easily retracts in respiratory distress r/t compliance
- Respiratory musculature
  - Diaphragm is primary breathing muscle
    - Infants and young children are abdominal breathers
    - Pressure on diaphragm affects ventilation
  - Intercostal muscles are not well developed until school age
  - Muscles lack tone, power & coordination-

Children cannot sustain a rapid respiratory rate for an extended period of time without fatigue →

RESPIRATORY FAILURE!!!



Breathing Assessment

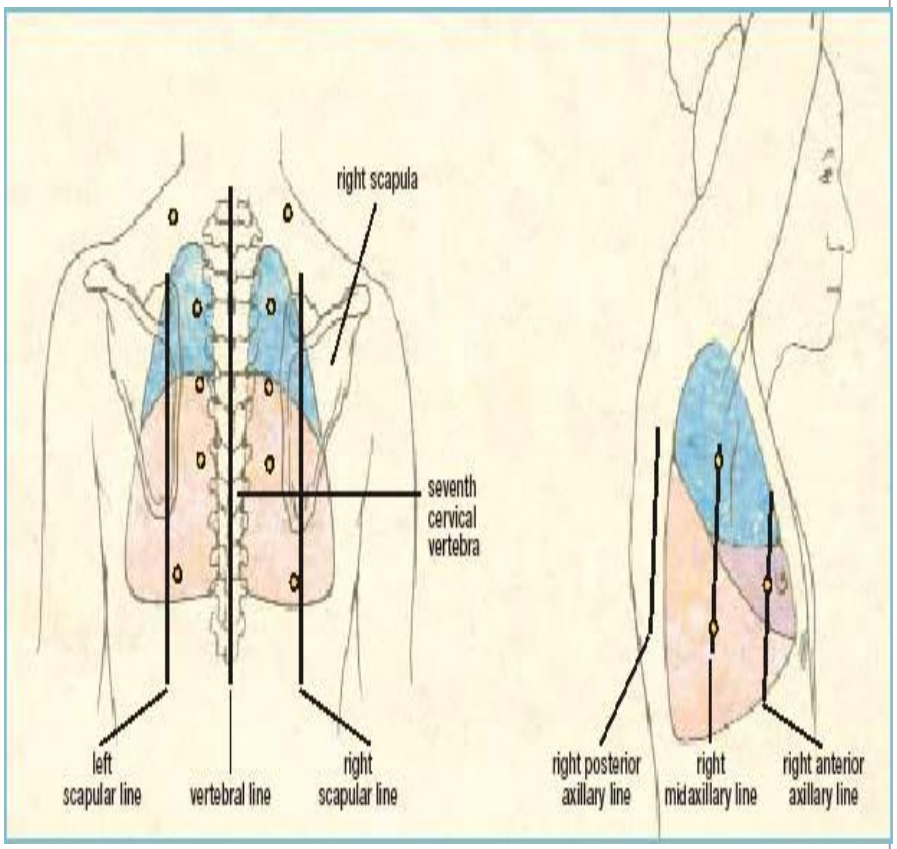
- RR – count for 30 seconds
- Red flags
  - RR<20/min in children<6 years old
  - RR< 12/min in children 6-15 years old
- Auscultation
- Oxygen saturation >90%
- Rate/depth of respirations
- Symmetry
- Skin color
- Lung sounds

Increased Work of Breathing

- Retractions = use of accessory muscles
- Nasal flaring
- Head bobbing – use of the neck muscles to improve breathing
- Abnormal airway positioning -Sniffing position or Tripod positioning
- Stridor, wheezing, grunting
- Tachypnea can be deceptive

Breathing/Ventilation

- Breath sounds
  - Easily transmitted through entire chest r/t thin chest wall
- Respiratory rate
  - Age specific
  - Irregular in infancy
  - Children increase RR to compensate for stress and increased O_2 demand

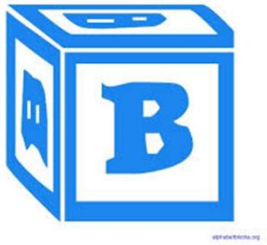


Breathing- Hypoxemia

- Children compensate for hypoxemia by ↑ RR (> 60/min) because don't have musculature to ↑ tidal volume
- Most pediatric Code Blues are related to respiratory arrest
- Adult Code Blues are related to a sudden cardiac event

Upper Airway Obstruction

- Airway swelling, infection, foreign body, poor control
- Common causes of stridor include:
  - Abscess on the tonsils
  - Airway injury
  - Allergic reaction
  - Croup – barking cough
  - Foreign body aspiration
  - Secretions such as phlegm (sputum)
  - Smoke inhalation or other inhalation injury
  - Swelling of the neck or face
  - Swollen tonsils or adenoids



Lower Airway Obstruction

- Involves bronchi
- Wheezing is a lower airway issue
- Common causes:
  - Asthma
  - Bronchiolitis

Respiratory Distress in Children

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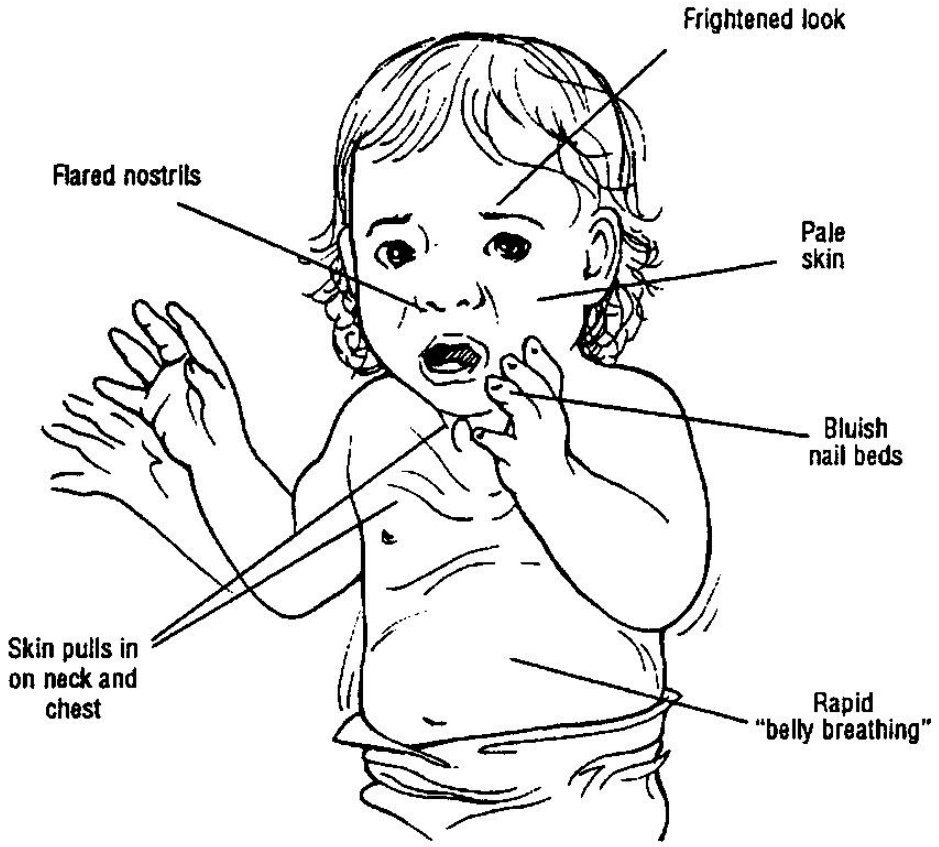


Circulatory System

- Normal HR varies by age
- Cardiac Output = Heart Rate x Stroke Volume
- Children cannot increase SV in response to increased CO needs therefore they must increase HR → tachycardia
- Tachycardia is a response to:
  - Fear, excitement, exercise
  - Dehydration
  - Increased metabolic demands (ie. Fever)
  - Hypoxemia- early
  - Pain
- Bradycardia is a response to:
  - Hypoxemia- late
  - Vagal stimulation- suctioning, intubation, head trauma
- Best sites to obtain capillary refill on infants:
  - Heel
  - Forearm

Heart Rates in Children

- Bradycardia in children is lethal
  - CO=HR x SV
- Take home pearl
  - *Pediatric Bradycardia is caused by hypoxia until proven otherwise*
- Be sure to always check pulses in all four extremities
- If you notice discrepancies or differences think cardiac issue

Circulatory System

- Dysrhythmias (rare in pediatrics)
  - Sinus tachycardia
  - Supraventricular tachycardia
  - Ventricular fibrillation- rare, associated w/ congenital or acquired heart disease
  - Asystole

- Blood pressure
  - HRXSV= CO
    - Can’t control SV as easily as HR
  - Decrease in BP is a late sign of decompensated shock

PEDIATRIC CARDIAC ARREST

Hypoxia and Hypercarbia

Respiratory Arrest

Bradycardia

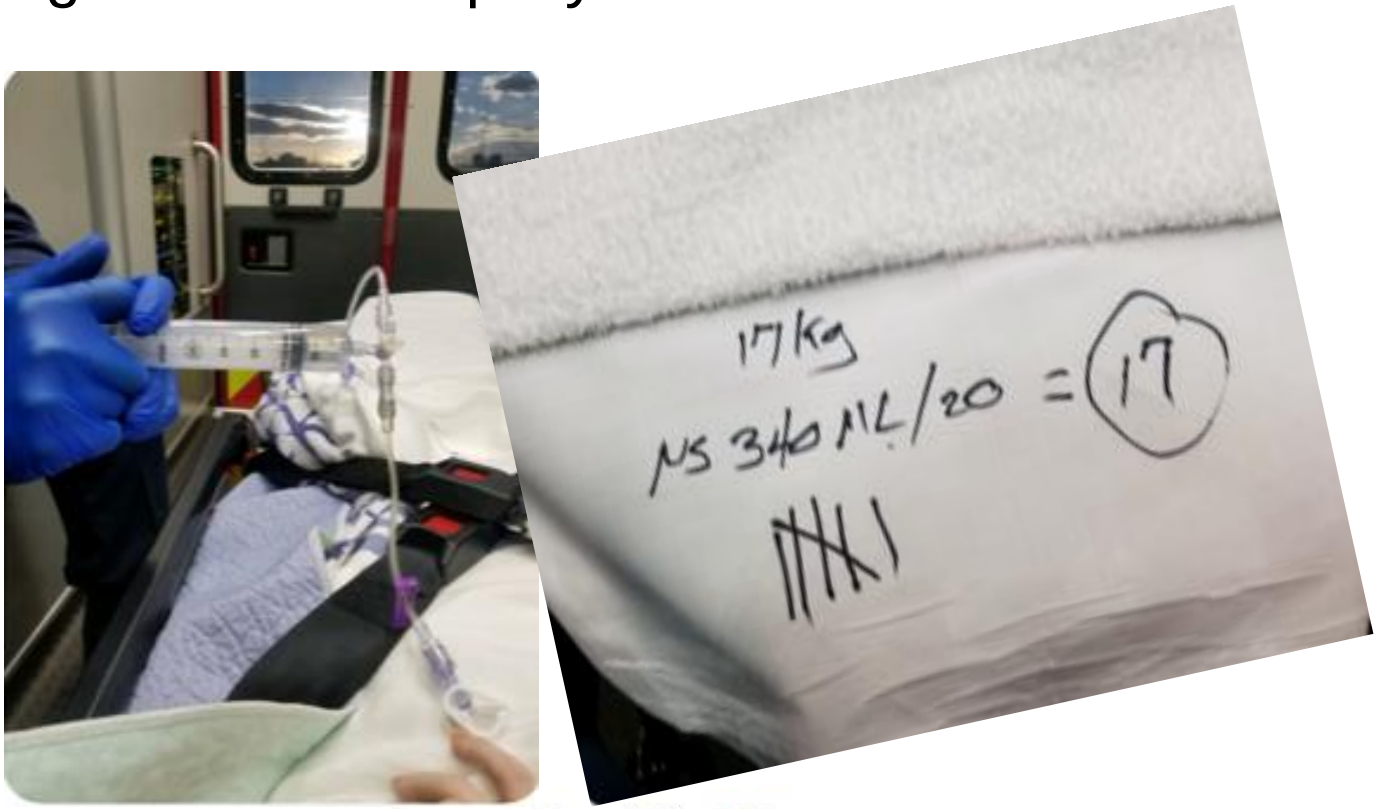
Cardiac Arrest

Blood Pressure

- Use a cuff 2/3 the length of the child's upper arm
- Hypotension
  - <60mmHg in newborns
  - <70mmHg in 1-12 months old
  - <70 + (2 x age) in 1-10 years old
  - <90mmHg if >10 years old
- Vascular or IO Access
- 10-20ml/kg Fluid Boluses then reassess and give another if needed.
  - Push-Pull Technique

Fluid Resuscitation

- Think fluid resuscitation vs fluid bolus for your sick kids.
- Want to get fluids on rapidly. How can we do this?



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Disability

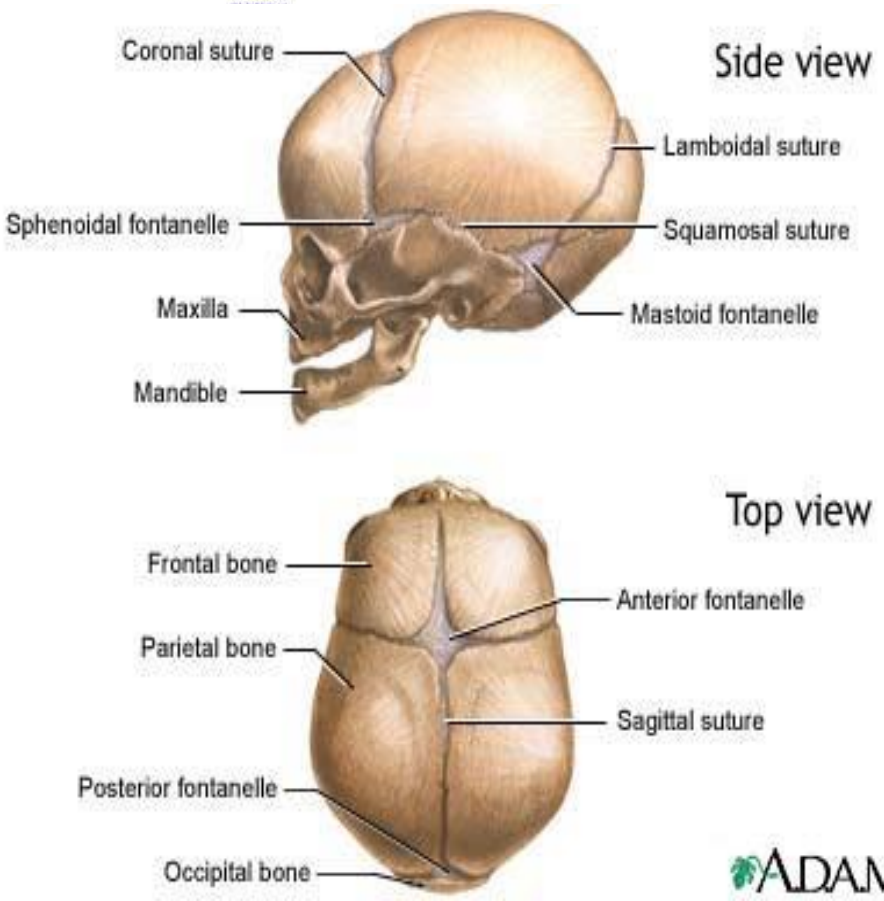
- AVPU: Alert, Verbal stimuli, Painful stimuli, Unresponsive
- Evaluate pupils
- Evaluate motor activity
- If abnormal, obtain vascular access, check glucose, begin isotonic fluids.
- GCS<8, intubate.
- Medications to reduce intracranial pressure, stop seizures.

Disability

- Change in LOC is most often related to oxygenation depletion
  - EX: lethargy, flaccid extremities, lack of interest in environment, poor feeding
- Irritability = a common response to illness
- Infants
  - Primitive reflexes intact?
    - Babinski, hand grasp, moro, suck/root
  - Are they able to calm with comfort?
- Older children
    - Fine Motor, Gross Motor & age appropriate milestones

Neurological System

Pediatric Head



- Sutures of skull
  - Not fully fused until 2 years
- Anterior fontanel
  - Closes at 12 & 18 months
  - Window to look at hydration!!
- Posterior fontanel
  - closes by 2-3 months

Exposure

- Disrobe child completely. If child alert, maintain modesty.
- Assess
  - Color, anomalies, birthmarks, moles
  - Cuts, bruises, burns, welts, bites
  - Pain, swelling, tenderness
  - Other signs of trauma
  - Skin turgor and mucous membranes

Integumentary System

- More difficult for infants and children to maintain body temperature than adults
  - Skin is thinner, more delicate, contains less SQ fat than adults
  - Body surface area to body mass ratio is greater for infants/children than adults
  - Infant < 6m cannot shiver to produce heat

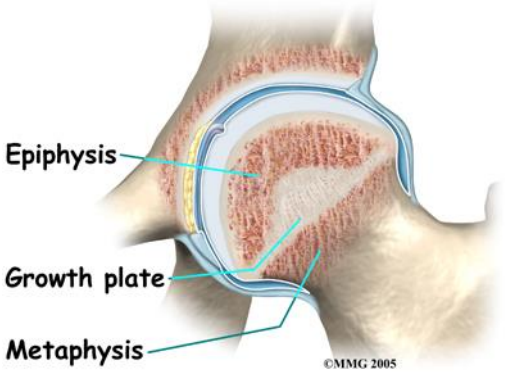
Secondary Assessment

- **F**ull set of Vitals/Family Presence
- **G**ive comfort measures
- **H**istory/Head-to-toe assessment
  - **S**igns/ Symptoms
  - **A**llergies
  - **M**edications
  - **P**ast Medical Problems
  - **L**ast food or liquid
  - **E**vents leading to the injury or illness
- **I**nspect posterior surfaces

Head to Toe Assessment Tips

- Weight
  - Accurate weights are key to pediatric drug dosing!
  - Weight in **kilograms**
  - **Broselow Tape or Handtevy**

Musculoskeletal System



- Bones
  - More porous and flexible in children
  - Frequent types of injury
    - Greenstick fracture
    - Spiral fx, rib fracture, scapular fx, metaphyseal fx

Musculoskeletal System

- Tendons and ligaments are strong and rarely sprain they are more likely to fracture
- Muscles throughout the body lack power, tone, coordination during infancy
  - Muscles account for 25% of body weight in infants vs 40% in adults
  - Respiratory and facial muscles most developed at birth

Case Review

- Scenario: You are dispatched to a home for a 6-year-old male in Respiratory Distress.
- Primary Assessment:
  - Appearance/Airway: Patent, Pt is lethargic, talking is short phrases, age appropriate, but just wants us to leave him alone. Awake with eyes closed, irritable, appears tired and uninterested. Lips are cracked
  - Breathing: Pt is lying down on the couch, mild subcostal retractions, looks to be breathing shallow. Intermittent cough. Upon auscultation: diminished lung sounds on right lower lobe and inspiratory wheezes are noted
  - Circulation: Cooler to touch, Cap refill 4-5
  - Disability: Pt is resting, answers questions appropriately
  - Exposure: Nothing noted at this time

Case Review:

- Initial Thoughts?

Case Review Cont:

- **Secondary Assessment:**
  - **Signs and Symptoms:**
  - Pt is coughing, wheezing, retractions, tachycardic, Nausea and c/o stomach ache.
  - **Allergies**: NKDA
  - **Medications:** Tylenol and Motrin
  - **Past Medical History:** PMH: none
  - **Last Meal:** few sips of juice today, soup last night
  - **Events:**. Mother reports 3 days of tiredness/lethargy, cough, nausea and complaints of stomach pain and fever. Pt refusing to eat/drink today. They are on vacation and he has been sick since they arrive.
- **Initial Vital Signs**: T 39.5 C (103.1 F) P 146 RR 44 BP 70/40 S_aO_2: 85% EtCO2: 28
- **Weight:** 20 kg Braslow, 22kg Handtevy

Case Review:

- Actions?
  - Airway- secure airway if necessary
  - Breathing- assist with breathing
    - Provided 100% oxygen by NRB mask
  - Circulation-
    - Place on monitors (CR and pulse-ox)
    - Access: Start and IV (2 if possible)
    - Normal saline/LR IV fluid bolus (400 ml) push pull method or pressure bag
  - Activate or State concerns for Sepsis

Case Review:

- Vitals
  - RR 14, severe retractions, labored
  - HR 80.
  - Decreased LOC
  - Vitals with Bag/mask:
  - T 40 Celsius/104 Fahrenheit

Case Review:

- Actions?
  - Recognize poor respiratory effort and begin bag-mask ventilation

Case Review

- Vitals with Bag/mask:
  - P 50
  - RR (rate being bagged)
  - BP 52/43
  - S_aO_2: 85%
  - EtCO2: 38

Case Review:

- Actions?
  - Begin CPR when pt's HR drops below 60
  - EPI (0.2mg, or 2mL 1:10,000)
  - Swap compressors
  - Gather necessary equipment
  - SOAP– Suction, Oxygen, Airway Equipment, Pharmacy)
  - Intubate/I-Gel?
  - Repeat bolus when first is complete – 400ml NS

PALS 2019 Update

- Use of extracorporeal membrane oxygenation (ECMO) with CPR (ECPR)
  - ECPR in settings with existing ECMO protocols, expertise, and equipment may be beneficial for selected patients for whom conventional CPR is ineffective after in-hospital cardiac arrest.
- Targeted temperature management after resuscitation:
  - For infants and children who remain comatose after resuscitation from in- or out-of-hospital cardiac arrest, it is reasonable to provide five days of normothermia (temperature 36 to 37.5°C), or to provide two days of therapeutic hypothermia (targeted temperature range 32 to 34°C) followed by three days of continuous normothermia.

2019 AHA update on pediatric advanced life support (December 2019)

PALS Medications

- Epinephrine – The IV/IO dose of epinephrine is 0.01 mg/kg (0.1 mL/kg of the 0.1 mg/mL concentration) given every three to five minutes.
  - Don't forget your EPI Sandwich
  - Use your 3 way stop cock
  - Don't forget to flush your EPI- Recommend handing flush with Epi
- Amiodarone – The initial IV/IO dose of amiodarone is 5 mg/kg (maximum single dose 300 mg). The 5 mg/kg (maximum 300 mg) dose can be repeated twice.
- Lidocaine – The initial IV/IO bolus dose of lidocaine is 1 mg/kg. This may be followed by an infusion of 20 to 50 mcg/kg/min. The bolus dose should be repeated if the lidocaine infusion is started more than 15 minutes after the initial bolus. Although lidocaine can be given through the endotracheal tube, the optimal dose is unknown. An increase of two- to threefold is suggested.
- Magnesium sulfate – The IV/IO dose is 25 to 50 mg/kg (maximum dose 2 g) given as an infusion of magnesium sulfate diluted in a 5 percent dextrose solution (D5W) to a concentration of 20 percent or less and, in an arrested patient, infused over one to two minutes.

PALS: Airway Tips and Tricks

- PALS- 28 days- puberty
- Maintain Airway:
  - Neck Role
  - End Title
  - Continuous monitoring
  - Keep hand on chest to feel if chest inflates
  - ONLY Bag until chest rise
- Insertion of a gastric tube helps to reduce gastric distension.
- Use "DOPE":
  - **D**: Dislodged or displaced endotracheal tube
  - **O**: Obstructed endotracheal tube
  - **P**: Pneumothorax
  - **E**: Equipment failure

PALS: $EtCO_2$

- A declining $EtCO_2$:
  - Improve quality of compressions
  - Avoid excessive ventilation
- Use $EtCO_2$ continuous waveform capnography during pediatric cardiac arrests
- Sudden, sustained increases in $EtCO_2$ during CPR are associated with a return of spontaneous circulation (ROSC).

Intraosseous Access in Pediatrics: Tips and Tricks

- Avoid Growth Plates!!!
- Manually press the needle through skin until the tip touches the bone.
- Squeeze the driver trigger and apply **light** steady downward pressure to penetrate the bone.
- Release the trigger when a sudden decrease in resistance is felt
- Aspirate bone marrow to identify correct placement of the IO
- The provider should ensure that the black line on the needle is still visible above the skin before drilling; otherwise, the needle will be too short to penetrate into the bone marrow cavity.
  - 15 mm (pink) suggested for placement in patients weighing 3 to 39 kg
  - 25 mm (blue) suggested for placement in patients ≥40 kg with normal subcutaneous tissue- can drill to first line for pts less than 40kg.

IO- Younger than one year of age

- Pink EZ-IO needle is rated for >3kg
- Newborns and preemies- consider Umbilical Line Access.
  - More info in NRP section
- Easily can be drilled through bone- manually insert needle or **very very** light pressure on drill.

IO's Statistics

- In a trial comparing success rates and time to insertion between IO and peripheral IV access among children requiring fluid resuscitation for severe dehydration in a hospital setting, the IO route was successful within five minutes for 100 percent of patients, as compared with 67 percent success within five minutes for peripheral IV placement .
- In a retrospective series describing attempts by paramedics to establish peripheral IV access for 300 children (0 to 18 years) in the prehospital setting, IV access was successful in two-thirds of all children and in only 49 percent of a subset of children younger than six years of age.
- IO vascular access was achieved in less than one minute for 85 percent of cases in a prospective report evaluating the time to insertion and success rate of IO cannulation in a variety of prehospital settings.
- In an observational study of 95 pediatric emergency department patients receiving IO placement with a battery-driven device, successful insertion and infusion were achieved in 94 percent of individuals. Insertion time was 10 seconds or less in 77 percent of the one-attempt successful cases who had time to insertion reported.

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Intraosseous cannula placement site by patient age

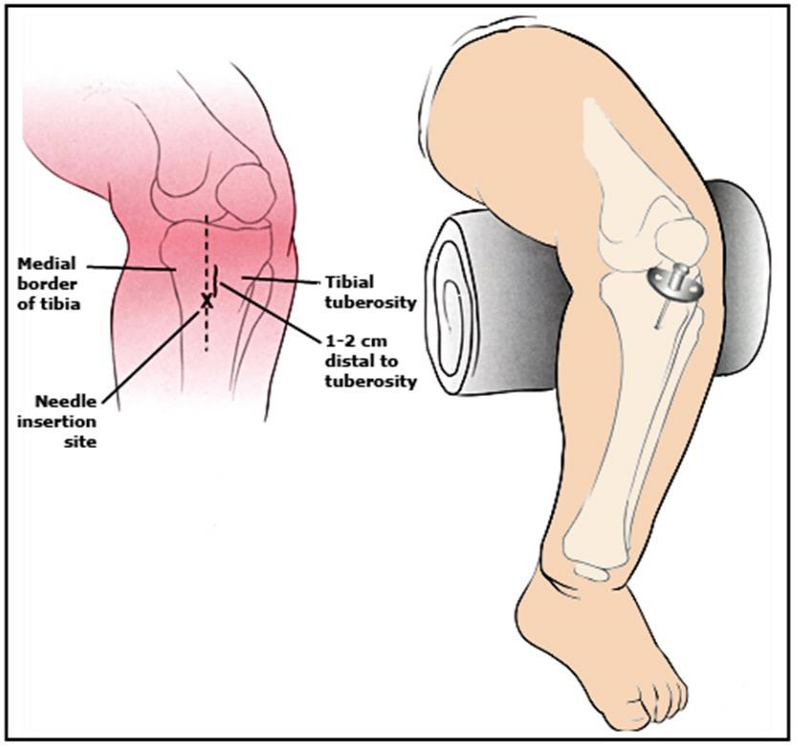
Patient age	Intraosseous site
Infant (under 1 year)	Proximal tibia
	Distal femur
Child (1-12 years)	Proximal tibia*
	Distal tibia or fibula
Skeletally immature adolescent¶ (12-18 years)	Proximal tibia*
	Distal tibia or fibula
	Sternum△
Over 18 years	Proximal tibia*
	Proximal humerus◇
	Distal tibia or fibula
	Sternum△

* Battery-powered or impact-driven devices are typically required to place an intraosseous cannula through the bony cortex of the proximal tibia in patients older than six years of age.
¶ Age at full skeletal maturity varies according to gender and individual patient characteristics.
△ Sternal intraosseous cannula placement should only be attempted using devices specifically designed for that placement site.
◇ The proximal humerus site should only be used in skeletally mature patients.

IO: Proximal Tibia

- Location:
  - Approximately 2 cm below the tibial tuberosity
  - Up to 1 cm medially on the tibial plateau.
- Placement avoids interfering with ongoing cardiac compressions.

Proximal tibial intraosseous access site

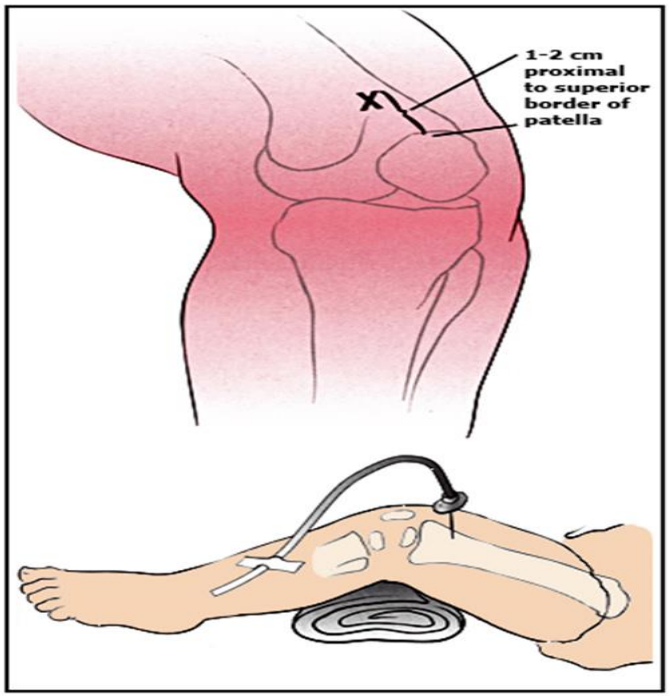


Entry site at the proximal tibia.

IO- Distal Femur

- Location:
  - Midline 1 to 2 cm above the superior border of the patella with the leg in extension.

Femoral intraosseous access site



Entry site at the distal femur.

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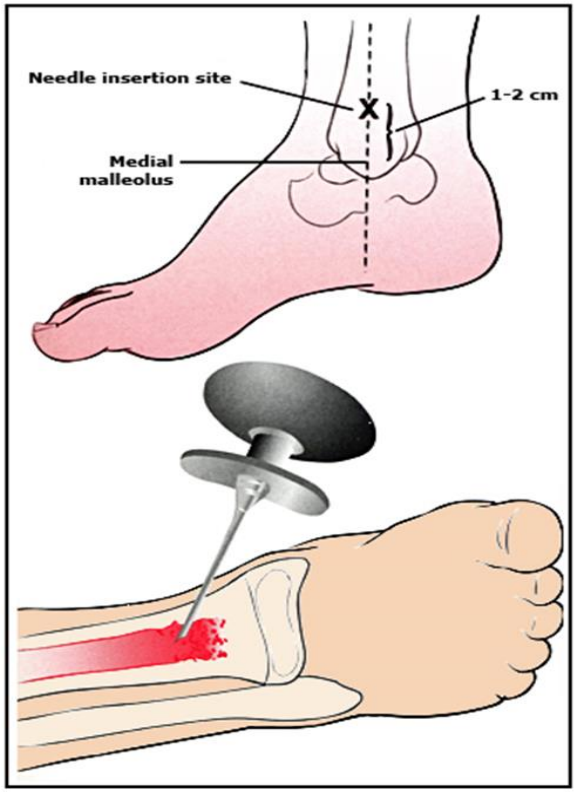
IO- Distal Tibia or Fibula

- The malleoli sites are approximately 1 to 2 cm superior to the malleoli in the bone's axis.
- The medial malleolus (distal tibia) is preferred to the lateral malleolus.

Distal tibial intraosseous access site



Entry site at the distal tibia.

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Peds Tips and Tricks Overview

- Proper airway techniques
  - Shoulder roll
  - Bag until chest rise
- CPR Ratios
  - Keep hands on chest to feel if you are getting chest rise
- Fluids
  - 10-20 mL/kg fluid bolus
  - 10 ml/kg: Prefilled NS syringes
  - 20 mL/kg: Push pull technique
- Drawing up Newborn/Pediatric Dose of Epi
  - Epi Sandwich
- Always check a Blood Sugar
- Color of Broselow/Handtevy in handoff/report
- Airway, Airway, Airway: Suction, with saline.
  - Infants are obligate nose breathers until 6 months of age.

NRP Review

- 0-28 days old
- Delayed cord clamping: 30-60 seconds for infant's less than 37 weeks
- Drying, stimulation and suctioning (if necessary) of the term healthy infant
- Apply pulse ox to right wrist: Pre-ductal
- Saturations will not be above >90% until 10 min of life

NRP Review: PPV

- MR SOPA if inadequate chest rise or improvement in HR
  - M= Mask (readjust)
  - R= Reposition (reposition head to open airway)
  - S= Suction
  - O= Open airway-jaw thrust
  - P= Pressure
  - A= Alternate airway (intubation/LMA/I-Gel)
- If possible, resuscitation of newborns equal to or greater than 35 weeks begins at 21% O2. Less than 35 weeks is 21-30% O2.
- Initiate PPV for apnea, gasping and HR <60
  - Flowmeter to 10L/min
  - Pressure of 20 cm H2O
  - PEEP of 5 H2O
  - *DO NOT OVERINFLATE Lungs*

NRP Review: Chest Compressions

- 3:1 – one and two and three and breathe…one and two and three and breathe- it's a waltz
  - 120 events (90 compressions+30 breaths) per minute
- Effective ventilations for 30 seconds before starting chest compressions if HR remains <60
- 2-thumb technique vs 1 finger
  - Opens up airway
  - Provides a "backboard"
- 60 seconds of compressions before assessing HR
  - Don't forget you can check a pulse at the stump of their umbilical cord.

NRP Review: Intubation

- Intubation is strongly recommended prior to chest compressions
  - ***Once intubated- YOU STILL PAUSE TO GIVE BREATHS***
- Laryngoscope blades
  - 00 for Preemies, 0 for most infants, 1 for large term infants
- CO2 detector with ETT placement
  - It takes several breaths to turn purple with extremely preterm infants.
  - CO2 detector may not change with poor circulation due to inadequate compressions or lack of volume.
- Don’t forget your I-GELS and LMA’s for infants over 33 weeks gestation

NRP Review: ETT

- ETT Depth:
  - kg+6= ~ tube depth

Endotracheal Tube (ETT)

Infant Weight	ETT Size	Approximate Tube Position
<1 KG	2.5	6-7 CM
1-2 KG	3.0	7-8 CM
>2 KG	3.5	8-9 CM

O_2 Saturation

1 min	60 - 65%
2 min	65 - 70%
3 min	70 - 75%
4 min	75 - 80%
5 min	80 - 85%
6 min	80 - 90%
8-10 min	85 - 95%

NRP: Access

- Access:
  - UVC is preferred method of vascular access.
    - Low lying UVC (insertion to point of blood return; approx. 4-5cms)
    - UVC- Fast Cath Insertion- using 14G Angiocath
  - PIV or IO as alternatives.

NRP: Emergency Medications

- Epinephrine:
  - IV= 0.1-0.3 ml/kg (1:10,000 concentration=0.1 mg/ml)
  - Consider if HR remains less than 60 after 30 seconds of good ventilation followed by another 30 seconds of coordinated chest compressions and ventilations
  - Do not give until good ventilation is established!
  - Give rapidly and wait 3 minutes between doses.
  - Check HR one minute after administration
- Crystalloid (NS and O-Rh Negative PRBC's):
  - 10ml/kg (use prefilled syringes)
  - Can be given if:
    - Infant is not responding to resuscitation or appears to be in shock
    - History of bleeding, abruption, previa, twin to twin transfusion
    - No obvious blood loss but persistent bradycardia
- Narcan: NOT RECOMMENDED
- Sodium Bicarbonate (NaHCO3): NOT RECOMMENDED

Newborn Thermoregulation:

- A normal healthy baby can go into shock from being cold!
  - Help yourselves- keep ALL Babies (especially sick) warm!!!
- Plastic bag on infants less than 32 weeks gestation
  - No drying, apply hat and place in bag.
  - Cutting hole for line placement or pulse-ox if needed
- Use of chemical mattress/warm IV bags- place blanket between baby and mattress/IV bags
- Increase temp in ambulance
- Hats and blankets

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