

PALS Helpful Hints 2020 Guidelines

- Airway - child is grunting - immediate intervention.
- Airway - deteriorates after oral airway, next provide bag-mask ventilation
- Airway - snoring with poor air entry bilaterally - reposition, oral airway
- AVPU - findings normal - rated as Alert
- CPR - 1 rescuer. 30:2 compression to ventilation ratio. 2 person 15:2 compression to ventilation
- CPR - after defibrillation resume compressions
- CPR - high quality component - allow complete chest wall recoil after each compression
- CPR - simultaneous pulse and breathing check no more than 10 seconds.
- CPR - you are alone with infant - Begin CPR for 2 minutes then leave to activate emergency response.
- Defibrillation - initial for 20 kg child - 40 J, with pulseless VT, VF 2 to 4 J/kg
- Fluid resuscitation - 10-20 ml/kg over 5 to 10 minutes (10 for neonates)
- I/O before vascular access - for cardiac arrest, an extremity with slow capillary refill time
- Labs - lethargy, Polyuria, onset rapid, deep, labored breathing - assess blood glucose
- Motor vehicle accident, immediate intervention for decreased level of consciousness.

Oxygen sat - below 90 while on oxygen - immediate intervention, - ideal 94% to 99% (not 94% to 100%)
Respiratory - distress - audible inspiratory stridor.

- Respiratory - failure - lethargic, rapid respiratory rate, tachycardic, most indicative of a low oxygen saturation.
- Respiratory - failure with fever, antibiotic is the most appropriate medication.
- Respiratory - lower airway - wheezing
- Respiratory - seizures, slow respirations - disordered control of breathing.
- Respiratory - unresponsive, respirations 6 per minute - provide bag-mask ventilation with 100% O₂.
- Respiratory - upper airway - increased work of breathing, inspiratory effort with retractions, stridor, nut allergy.
- Respiratory - upper airway obstruction drug - nebulized epinephrine.
- Respiratory - distress from lung tissue disease - crackles.
- Rhythm - bradycardia, no pulse - pulseless electrical activity
- Rhythm - hypoxia most likely cause of bradycardia in an infant.
- Rhythm - pulse above 180 Narrow complex, regular - Supraventricular tachycardia.
- Rhythm - rate slow, sinus bradycardia.
- Rhythm - Supraventricular tachycardia, hypotensive - synchronized cardioversion.
- Shock - distributive, septic - fever, lactic acidosis, antibiotic as an early intervention.
- Shock - fever, hypotensive - IV 10 - 20 mL/kg of isotonic crystalloid over 5 to 10 minutes.
- Shock - hypotensive - best assessment variable is blood pressure, 55/40 for 2-week-old.
- Shock - hypovolemic - history vomiting, diarrhea
- Shock - severity, compensated or not is determined by the blood pressure, not other variables.
- Team dynamics - out of scope: team member should ask for a new task or role.

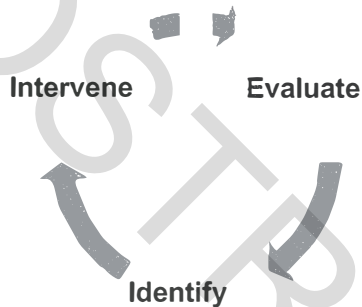
Team dynamics - wrong dose by team leader, respond "I think the correct dose is.... should I give instead?"

- Vital Signs - Heart rate 88 is normal for a 10-year-old, respiratory rate 24 normal for 3 year old.
- Vomiting, diarrhea asses blood glucose first

Initial Assessment

- Appearance
- Work of Breathing
- Circulation (color)

Evaluate – Identify - Intervene



A continuous sequence.
Determine if problem is life threatening.

EVALUATE

PRIMARY ASSESSMENT

- **A**irway – Patency, Open airway
- **B**reathing – Breath Sounds
- **C**irculation – Heart Rate, Skin
- **D**isability - Level of Consciousness
 - AVPU - alert, voice, painful, unresponsive
 - Glasgow Coma Scale, Pupils
 - Blood glucose
- **E**xposure - Temperature

SECONDARY ASSESSMENT

6 Hs 5 Ts -Search for Reversible Causes

H's	T's
H ypovolemia	T ension pneumothorax
H ypoxia	T amponade, cardiac
H ydrogen ion (a cidosis)	T oxins – poisons, drugs
H ypoglycemia	T hrombosis – coronary (AMI)
H ypo /hyper kalemia	T hrombosis – pulmonary (PE)
H ypothermia	

- ♥ **Focused medical history**
- ♥ **Focused physical exam**
- ♥ **Ongoing reassessment**
 - S**- Signs & symptoms (What hurts?)
 - A**- Allergies
 - M**- Medications
 - P**- Past medical history
 - L**- Last meal
 - E**- Events Preceding, what happened

DIAGNOSTIC ASSESSMENT

- ABG, Venous blood gas, arterial lactate
- Central venous O₂ saturation, CVP
- CXR, ECG, Echo
- Peak expiratory flow rate

IDENTIFY

- Type and Severity of Potential Problems

<u>Respiratory</u>	<u>Circulatory</u>
Respiratory Distress	Compensated Shock
Or	Or
Respirator Failure	Hypotensive Shock
Upper airway obstruction	Hypovolemic shock
Lower airway obstruction	Distributive shock
Lung tissue disease	Cardiogenic shock
Disordered control of breathing	Obstructive shock

Cardiopulmonary Failure

Cardiac Arrest

INTERVENE

- Positioning the child to maintain a patent airway
- Activating emergency response
- Starting CPR
- Obtaining the code cart and monitor
- Placing the child on a cardiac monitor and pulse oximeter
- Administering O₂
- Supporting ventilation
- Starting medications and fluids using nebulizer, IV/IO fluid bolus

An intubated patient's condition deteriorates; consider the following possibilities (DOPE):

- **D**isplacement of the tube from the trachea
- **O**bstruction of the tube
- **P**neumothorax
- **E**quipment failure

PALS Study Guide 2020 Guidelines

BLS Review for Child and Infant

Assessment Steps for BLS

- Make sure scene is safe
- Tap/shout to check for responsiveness
- Call for help if patient is unresponsive
- Check for pulse and breathing for at least 5 but no more than 10 seconds
- If no pulse (or not sure if there is a pulse) begin CPR

If alone and witnessed collapse, immediately activate EMS/AED before CPR

- If alone and not witnessed, do 2 minutes of CPR before activating EMS/AED

Breaths During CPR

- Compressions to breaths ratio 30:2 if single rescuer
- Compressions to breaths ratio 15:2 with 2 rescuers
- Each breath given over 1 second
- An effective breath will result in visible chest rise
- CPR with ETT: 1 breath every 2-3 seconds with continuous compressions
 - Verify ETT placement: waveform capnography

Effective Team Dynamics

1. Clear roles and responsibilities: Team leader should clearly delegate tasks
2. Knowing your limitation: Stay in scope of practice / ask for a new role if inappropriately assigned
3. Constructive interventions: if someone is about to make a mistake address that team member immediately
4. Knowledge sharing
5. Summarizing and Re-evaluation
6. Closed loop communication: Repeat back the order
7. Mutual respect

Compressions

- Compress at least one-third the depth of the chest
- Compress at a rate between 100 – 120/min
- Allow for full Chest recoil between compression
- PETCO₂ (intubated) < 10 mmHg indicates poor compressions
- Interruptions in compressions should be < 10 seconds
- Switch compressors every 2 min.

Rescue Breathing

- For a patient who is not breathing or breathing effectively
- Give 1 breath every 2-3 seconds
- Each breath given over 1 second
- An effective breath will result in visible rise/fall of the chest
- Excessive ventilation decreases cardiac output

- Difficulty positioning airway for patency, place NPA or OPA
- OPA Placement = Measure from the corner of the mouth to the angle of the mandible

Systemic Approach

Initial Impression

- This is a quick “doorway” assessment looking at the child’s Appearance, Work of Breathing, and Circulation
- Is the child in failure or distress?

Primary Assessment

- Airway
- Breathing
- Circulation
- Disability
- Exposure

Secondary Assessment

- Head to Toe Physical
- History: SAMPLE
 - Signs and Symptoms
 - Allergies
 - Medications
 - Past Medical History
 - Last Meal
 - Events leading up to admission

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Respiratory

- Grunting, associated with **Lung Tissue Disease**, is an attempt to maintain positive pressure and prevent collapse of the alveoli and small airways. Patient should be evaluated quickly, it may indicate respiratory distress or respiratory failure.
- **Upper Airway Obstructions** usually is associated with abnormal sounds (Stridor, hoarseness,) and increased WOB during the inspiratory phase. Examples include croup, epiglottitis, foreign body, and anaphylaxis.
- **Respiratory Failure** is inadequate Oxygenation or inadequate Ventilation, or both.

Common Respiratory Complications

Upper Airway Obstruction

- Inspiratory Stridor is a common finding
- Foreign Body, Croup, Epiglottitis, Anaphylaxis, Trauma
- VS, oxygen, monitor, IV, CXR, possible blood gas
- Nebulized Epi (Racemic Epinephrine), Steroids
- Keep child calm to prevent situation from worsening

Lung Tissue Disease

- Expiratory Grunting is a common finding
- Crackles often heard on auscultation
- Hypoxemia despite oxygen administration
 - Pneumonia
- O₂, monitor, IV, CXR, blood gas, CBC, Cultures
- Antibiotics within first hour, provide supportive care

Lower Airway Obstruction

- Expiratory Wheezing is a common finding
- Asthma, Bronchiolitis
- VS, oxygen, monitor, IV, CXR, possible blood gas
- Bronchodilator (Albuterol)
- Consider CPAP or BiPAP

Disordered Control of Breathing

- Absent or abnormal breathing
- Toxins, poisons, head trauma, seizures
- Ensure adequate oxygen **and** ventilation
- Treat the underlying cause to correct

Shock / Circulatory

- **IO placement** is an acceptable option if IV access cannot quickly be established. Contraindications to IO placement include previous attempts, infection, or crush injury in the same extremity.
- In Shock but BP is acceptable = **Compensated** / BP is unacceptable = **Hypotensive**
 - Acceptable BP is $70 + 2(\text{age in years})$. Example: 4 y/o is compensated if his systolic pressure is greater than 78.

Common Shock / Circulatory Complications

Hypovolemic Shock

- Blood or fluid loss
- Treat with fluid bolus and consider blood products
- Standard bolus: 20cc/kg of Isotonic Crystalloids (NS)
- Deliver bolus over 5 to 10 minutes

Cardiovascular Shock

- Pulmonary edema and possible enlarged heart
- Consult Cardiology / 12 lead / Ultrasound
- Consider smaller/slower boluses if needed (10cc/kg)
- Consider CPAP/BiPap to mobilize fluids

Obstructive Shock

- Must fix the underlying cause
- Examples: Cardiac Tamponade, Tension Pneumothorax
- Consider CPAP or BiPAP
- Tension Pneumothorax most common = needle decompression and chest tube

Distributive Shock

- More common in individuals with a weak immune system such as cancer patients
- Support oxy and ventilation, support blood pressure
- Antibiotics within the first hour

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Vital Signs in Children - Normal Ranges

Age	Systolic BP	Pulse (awake)	Respirations
Neonate	67-84	100-205	
Infant	72-104	100-190	30-53
Toddler	86-106	98-140	22-37
Preschooler	89-112	80-120	20-28
School-aged	97-115	75-118	18-25
Adolescent	110-131	60-100	12-20

Treatment of Dysrhythmias - general overview. See book for details

Bradycardia

- ♥ Maintain patent airway, assist breathing positive pressure ventilation, O₂ if needed, monitor
- ♥ ABCs, consider oxygen, observe, 12 lead, identify and treat underlying causes
- ♥ Bradycardia persists: IV/IO, Epinephrine 0.01 mg/kg, Atropine 0.02 mg/kg may repeat 1x, consider pacing, treat underlying causes
- ♥ Continuous CPR if heart rate below 60

Tachycardia with a Pulse

- ♥ Maintain patent airway, assist breathing as necessary, oxygen, monitor, pulse, BP, oximetry
- ♥ Sinus tach – treatable causes, rhythm in infants/children may be slightly regular or irregular
- ♥ SVT – asymptomatic consider vagal maneuvers and give adenosine if IV/IO present
- ♥ SVT – rhythm regular - infant rate above 220, child above 180 SVT - adenosine 0.1 mg/kg rapid bolus (max 6 mg), repeat 0.2 mg/kg rapid bolus (max 12 mg)
- ♥ No IV/IO, adenosine not successful, cardioversion
- ♥ QRS wide? - Probable V tach - 12 lead, adenosine as above, synchronized cardioversion 0.5 to 1 J/kg then 2 J/kg. Sedate if needed. Don't delay cardioversion

Pediatric Cardiac Arrest - H's T's

- CPR – If no advanced airway 15:2 compression to ventilation. If advanced airway breath every 2 – 3 seconds, bag/mask, O₂, monitor/defib
- Shockable (VF/VT) – CPR 2 min,
 - shock 2 J/kg, then 4 J/kg to max of 10 or adult dose
 - epinephrine 0.01 mg/kg repeat 3 to 5 min (max 1 mg)
 - Amiodarone 5mg/kg repeat up to 3 times or lidocaine 1 mg/kg
- Non-shockable (asystole/pea) – CPR 2 minutes
 - Epinephrine ASAP epinephrine 0.01 mg/kg repeat 3 to 5 min (max 1 mg)
 - Treat reversible causes

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Respiratory - see PALS text for full details

Managing Respiratory Emergencies Flowchart		
<ul style="list-style-type: none"> • Airway positioning • Suction as needed 	<ul style="list-style-type: none"> • Oxygen • Pulse Oximetry 	<ul style="list-style-type: none"> • ECG as Indicated • BLS as indicated
Upper Airway	Croup	<ul style="list-style-type: none"> ▪ Nebulized epinephrine ▪ Corticosteroids
	Anaphylaxis	<ul style="list-style-type: none"> ▪ IM epinephrine (or autoinjector) ▪ Albuterol ▪ Antihistamines ▪ Corticosteroids
	Aspiration Foreign Body	<ul style="list-style-type: none"> ▪ Allow position of comfort ▪ Specialty consultation
Lower Airway Obstruction	Bronchiolitis	<ul style="list-style-type: none"> ▪ Nasal Suctioning ▪ Consider bronchodilator trial
	Asthma	<ul style="list-style-type: none"> ▪ Albuterol + ipratropium ▪ Corticosteroids ▪ Magnesium sulfate ▪ IM epinephrine (if severe) ▪ Terbutaline
Lung Tissue Disease	Pneumonia/pneumonitis Infectious Chemical Aspiration	<ul style="list-style-type: none"> ▪ Albuterol ▪ Antibiotics (if indicated) ▪ Consider noninvasive or invasive ventilatory support with PEEP
	Pulmonary edema Cardiogenic or noncardiogenic (ARDS)	<ul style="list-style-type: none"> ▪ Consider noninvasive or invasive ventilatory support with PEEP ▪ Consider vasoactive support ▪ Consider diuretic
Disordered Control of Breathing	Increased ICP	<u>Avoid:</u> <ul style="list-style-type: none"> ▪ Hypoxemia ▪ Hypercarbia ▪ Hyperthermia ▪ Hypotension
	Poisoning/Overdose	<ul style="list-style-type: none"> ▪ Antidote (if available) ▪ Contact poison control
	Neuromuscular disease	<ul style="list-style-type: none"> ▪ Consider noninvasive or invasive ventilatory support

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Signs of compensated shock include (poor perfusion, NORMAL systolic BP)

- Tachycardia
- Increased SVR
 - Skin - cold, pale, mottled, diaphoretic
 - Peripheral circulation - delayed capillary refill
 - Pulses - weak peripheral pulses, narrowed pulse pressure
- Increases renal and splanchnic vascular resistance (redistribution of blood flow)
 - Kidney - decreased urine output, oliguria
 - Intestine - vomiting, ileus
- Cerebral auto regulation - brain, altered mental status, anxiety, coma
- **Normal blood pressure**

Signs of decompensated shock include

As compensatory mechanisms fail, signs of inadequate end-organ perfusion develop. In addition to the above, these signs include

- Depressed mental status, decreased urine output
- Metabolic acidosis, Tachypnea, Weak central pulses
- **Hypotension**

The most common cause of shock is hypovolemia, one form of which is hemorrhagic shock. Distributive and cardiogenic shock are seen less often.

- Capillary refill time alone is not a good indicator of circulatory volume, but a capillary refill time of >2 seconds is a useful indicator of moderate dehydration when combined with a decreased urine output, absent tears, dry mucous membranes, and a generally ill appearance.
- Tachycardia also results from other causes (e.g., pain, anxiety, fever).
- Pulses may be bounding in anaphylactic, neurogenic, and septic shock.

In compensated shock, blood pressure remains normal; it is low in decompensated shock. Hypotension is a *systolic* blood pressure less than the 5th percentile of normal for age.

Pediatric Cardiac Arrest Medications

Medication	Dose	Remarks
Epinephrine	Pulseless arrest, symptomatic bradycardia 0.01 mg/kg IV/IO q 3 to 5 min Symptomatic Brady – 0.01 mg/kg	Doses vary for other conditions and situations
Atropine	Bradycardia - 0.02 mg/kg IV/IO q 3 to 5 min 0.04 to 0.06 mg/kg ET	Child max 1 mg total dose Adolescent max 3 mg total dose
Adenosine	SVT 0.1 mg/kg IV/IO rapid push max 6 mg Repeat 0.2 mg/kg max 12	Rapid push closest port followed by fluid bolus 5-10 ml NS
Amiodarone	SVT, VT with pulse 5 mg/kg IV/IO Pulseless arrest 5 mg/kg IV/IO Total 15 mg/kg, max single dose 300 mg	load over 20-60 min may produce prolonged QT
Naloxone	0.1 mg/kg IV/IO/IM bolus q 2 min	max 2 mg ½ life is short, repeated dosing May wake up agitated
Lidocaine	VF/ Pulseless VT 1 mg/kg IV/IO bolus. 2 to 3 mg/kg ET	Maintain 20 to 50 mcg/kg/min
Dextrose Glucose	0.5 to 1 g/kg IV/IO	Use bedside glucose check to confirm hypoglycemia
Magnesium Sulfate	Asthma refractory 25 to 50 mg/kg IV/IO Pulseless V-tach Torsades 25 – 50 mg/kg	Max 2 G May cause bradycardia

PALS Helpful Hints 2020 Guidelines

Shock - see PALS text for full details

Managing Shock Flowchart		
<ul style="list-style-type: none"> • Oxygen • Pulse Oximetry 	<ul style="list-style-type: none"> • ECG Monitor • IV/IO access 	<ul style="list-style-type: none"> • BLS as indicated • Point of care glucose testing
Hypovolemic Shock	Nonhemorrhagic	<ul style="list-style-type: none"> ▪ 20 ml/kg NS/LR bolus, repeat as needed ▪ Consider Colloid
	Hemorrhagic	<ul style="list-style-type: none"> ▪ Control external bleeding ▪ 20ml/kg NS/LR bolus, repeat 2 or 3x as needed ▪ Transfuse PRBC's as needed
Distributive Shock	Septic	<ul style="list-style-type: none"> ▪ See Septic Shock Algorithm <ul style="list-style-type: none"> ○ Support ABCs ○ HR, BP, Pulse Oximetry, IV/IO ○ 10 – 20 ml/kg isotonic crystalloid bolus (assess). Stop if resp distress, hepatomegaly ○ Blood culture, lab studies, glucose ○ Broad spectrum antibiotics (After cultures) ○ Antipyretics if needed
	Anaphylactic	<ul style="list-style-type: none"> ▪ IM epinephrine (or autoinjector) ▪ Fluid bolus (10 – 20 ml/kg NS/LR) ▪ Albuterol, Antihistamines, Corticosteroids ▪ Epinephrine infusion
Cardiogenic Shock	Bradycardia Tachycardia	<ul style="list-style-type: none"> ▪ Management algorithms
	Other: CHD, myocarditis, cardiomyopathy, poisoning	<ul style="list-style-type: none"> ▪ 5 – 10 ml/kg NS/LR bolus, repeat PRN ▪ Inotropic and/or vasoactive infusions ▪ Consider expert consultation ▪ Antidote for poisoning
Obstructive Shock	Ductal-dependent (LV outflow obstruction)	<ul style="list-style-type: none"> ▪ Prostaglandin E1 ▪ Expert consultation
	Tension Pneumothorax	<ul style="list-style-type: none"> ▪ Needle decompression ▪ Tube thoracostomy
	Cardiac tamponade	<ul style="list-style-type: none"> ▪ Pericardiocentesis ▪ 20 m/kg NS/LR bolus
	Pulmonary embolism	<ul style="list-style-type: none"> ▪ 20 ml/kg NS/LR bolus, repeat PRN ▪ Consider thrombolytics, anticoagulants ▪ Expert consultation

PALS Providers

Supplemental Study Guide 2020

Pediatric Chain of Survival

IHCA: Early Recognition and Prevention → Activation of Emergency Response → High-Quality CPR → Defibrillation → Post-Cardiac Arrest Care → Recovery

OHCA: Activation of Emergency Response → High-Quality CPR → Defibrillation → Advanced Resuscitation → Post Cardiac Arrest Care → Recover

BLS

- BLS Sequence: **C A B: Circulation, Airway, Breathing**
- Verify scene safety.
- Check for responsiveness.
- No breathing or only gasping (Agonal respirations are **NOT** adequate respirations) and
- No definite pulse felt within 10 seconds, begin compressions.
- If pulse is less than 60 (**despite oxygenation and ventilation**), begin compressions.
- Breathing and pulse check can be performed simultaneously in less than 10 seconds.
- Shout for help. If a mobile device is available, phone emergency services (**9-1-1**).

Compressions

Rate - 100 to 120/minute

Ratio - Single rescuer 30 compressions to 2 breaths

Two rescuer 15 compressions to 2 breaths

Depth - at least 1/3 the depth of chest or approximately 2 inches/5cm (child)

1 ½ inches/4cm (infant)

Technique - Child - one/two hand(s) lower half of sternum

Single rescuer infant – 2 fingers or 2 thumb-encircling in the center of the chest, just below the nipple line

2 or more rescuers - 2 thumb-encircling in the center of the chest, just below the nipple line

- If the rescuer is unable to achieve the recommended depth, it may be reasonable to use the heel of one hand.
- Allow complete recoil of chest after each chest compression; do not lean on the chest after each compression.
- Switch compressors every 2 minutes or when AED analyzes rhythm to avoid fatigue & poor compression quality. The switch should take less than 5 seconds, resuming compressions in less than 10.
- Opioid OD management includes CPR and timely administration of Narcan. (Lay Rescuer included)

Airway/Breathing

- Open airway by using head tilt-chin lift maneuver while keeping mouth open (jaw thrust for trauma victim).
- Ventilate **JUST** enough to see chest rise. Avoid increasing intrathoracic pressure (which will decrease cardiac output).
- Cardiac arrest with advanced airway – continuous compressions, ventilate one every 2-3 seconds (20-30/min).
- If the patient has a pulse and inadequate or no respirations – begin rescue breathing, ventilate one every 2-3 seconds (20-30/min)

AED

- Turn on – follow prompts.
- Apply hands-free pads as quickly as possible.
- Use child pads for infants and children < 8 years of age. Adult pads may be used with or without a pediatric attenuator. Make sure the pads do not touch or apply A/P.
- If a shock advised, continue compressions while the AED is charging.
- Immediately after the shock is delivered, resume compressions.
- Never delay compressions, even if the AED is not functioning properly.
- It is ok to use the AED if the patient is lying in snow.
- In infants, a manual defibrillator is preferred over the use of an AED.

Resuscitation and Defibrillation

Assign a CPR Coach. The CPR Coach will perform the Monitor/Defibrillator and will not switch from that role.

Pre-charge the defibrillator 15 seconds before a 2-minute rhythm analysis (deliver shock immediately if VF or pVT on the monitor). Discharge if non shockable rhythm and no pulse. Rationale: Ideally your patient should not be without compressions for longer than 5 seconds.

Perform a pulse check during the pre-charge phase in anticipation of an organized rhythm during analysis.

- First shock 2 J/kg
- Second shock 4 J/kg
- Subsequent shocks ≥ 4 J/kg – maximum 10 J/kg or adult dose

Epi 0.01mg/kg (1:10,000) IV/IO is your first line drug in all cardiac arrests. Administer after the second shock if treating VF or pVT, during compressions. Administer **ASAP** (ideally within 5 minutes) if PEA/Asystole. Repeat every 3-5 minutes. Search for reversible causes using Hs and Ts.

Amiodarone 5mg/kg bolus - may be repeated up to 3 doses **OR**
Lidocaine Initial: 1mg/kg loading dose

IO access may be considered **if attempts at IV access are unsuccessful or are not feasible**. The IV route is associated with better clinical outcomes.

Monitor the quality of compressions with CO₂ (PETCO₂) with a goal of 10-15 mm Hg (ideally 20). ROSC occurs and is identifiable by an abrupt increase.

For patients with arterial lines in place, using feedback from continuous measurement of arterial blood pressure may improve CPR quality.

Capnography

AHA guidelines stress the use of Capnography. Capnography shows a graphic display and measurement of CO₂ levels in the airways. Normal reading in a healthy patient is 35-45 mmHg. Continuous waveform Capnography is the most reliable method of confirming and monitoring ET tube placement and effectiveness of compressions. End tidal CO₂ during chest compressions should be greater than 10-15 mmHg. Ideally, 20 mmHg. If values are less than 10-15 mmHg, cardiac output during CPR is indicative of low blood flow being delivered to the lungs. Return of Spontaneous Circulation (ROSC) is indicated by the abrupt increase in PETCO₂.

Post Cardiac Arrest Care (PCAC)

- Optimize Oxygenation and Ventilation
 - Target normoxemia 94%-99%.
 - Target Paco2 appropriate to the patient's underlying condition.
- Hemodynamic monitoring
 - Target systolic blood pressure greater than the 5th percentile; 1-12 months < 70, 1-10 years < 70 + (age in years x 2), >10 years < 90. Monitor arterial blood pressure. Fluid bolus for hypotension is 20ml/kg of isotonic crystalloid; consider 10ml/kg if poor cardiac function is suspected. Consider inotropes or vasopressors.
- Targeted Temperature Management (TTM)
 - Prevent and treat fever immediately after arrest and during rewarming.
 - If patient is comatose apply TTM (32°C-34°C) followed by (36°C-37.5°C) or only TTM (36°C-37.5°C).
- Monitor for and treat agitation and seizures.
- Monitor for and treat hypoglycemia.
- Monitor electrolytes within normal ranges to avoid possible life-threatening arrhythmias.

Bradycardia

Assess for cardiovascular compromise. (Acutely altered mental status, signs of shock, hypotension). Start CPR if rate is less than 60, **despite oxygenation and ventilation**. Hypoxia is the leading cause of bradycardias in children. If unsuccessful, the initial drug for treatment is Epinephrine 0.01 mg/kg (1:10,000) IV/IO. Atropine 0.02 mg/kg (maximum single dose 0.5 mg) IV/IO may be given for a bradycardia associated with sustained vagal tone or primary AV block. Consider TCP. Identify and treat possible causes. (Hypoxia, Hypothermia, Toxins, etc.)

Tachycardia

Unstable tachycardias - perform synchronized cardioversion.

0.5 - 1 J/kg; if not effective, increase to 2 J/kg. Consider sedation but do not delay cardioversion.

Stable SVT

- Vagal maneuvers prior to drug administration. Small children, ice to face. Older children blow on thumb or syringe.

- Adenosine 0.1 mg/kg rapid bolus (maximum 6mg) may repeat with 0.2 mg/kg rapid bolus (maximum 12 mg).

Stable V-Tach

- If rhythm is **regular** and QRS **monomorphic**, consider Adenosine.
- Expert consultation is recommended
- Amiodarone may be ordered at 5 mg/kg over 20 to 60 minutes.
- It is extremely rare in children. Check for metabolic or toxicology causes.

Respiratory

Increased respiratory effort signs may include:

- nasal flaring, retractions, head bobbing, seesaw respirations, open mouth breathing, gasping, or prolonged inspiratory/expiratory times

Respiratory distress – a clinical state characterized by increased respiratory effort, rate, and work of breathing.

Respiratory failure – inadequate oxygenation and ventilation or both. It requires intervention to prevent impending cardiac arrest.

Signs include:

- **extreme tachycardia/bradycardia, bradypnea/apnea, poor/absent air movement, cyanosis, and lethargy/unresponsiveness**

*If SpO₂ is <90 despite 100% oxygen, this indicates hypoxemia and respiratory failure.

Upper Airway Obstruction - (Croup/Anaphylaxis/Foreign Body Airway Obstruction)

– nose, larynx, or pharynx

Signs: increased respiratory effort, (**inspiratory**) stridor, retractions, nasal flaring, and barking cough

Treatment: positioning, humidified O₂, **Nebulized** Epi, Corticosteroids, IM Epi, Antihistamines, keep calm (may consider Heliox)

Lower Airway Obstruction – (asthma, bronchiolitis) – trachea, bronchi, or bronchioles

Signs: increased respiratory effort, typically (**expiratory**) wheezes, prolonged expiratory phase, nasal flaring

Treatment: positioning, Corticosteroids, Albuterol/Atrovent, IM Epi, Mag Sulfate, Terbutaline, keep calm.

Lung Tissue Disease – (pneumonia, pneumonitis, infections, chemicals, aspiration, pulmonary edema, ARDS, pulmonary contusion from trauma) – occurs within alveolar and/or parenchyma.

Signs: increased respiratory effort, tachypnea, grunting, crackles, diminished breath sounds
*Grunting is typically a compensatory sign to maintain positive pressure and prevent collapse of the alveoli and small airways. Identify and treat causes **immediately**.

Treatment: diagnostic assessments, antibiotics, albuterol, CPAP

Disordered Control of Breathing – (neurological disorders, increased ICP, CNS dysfunction, head injury, hydrocephalus, and conditions that depress LOC - such as deep sedation, poisoning, drug overdose, seizures)

Signs: variable

Treatment: avoid hypoxemia, hypercarbia, hyperthermia, hypotension, antidote (if available), ventilatory support

DOPE: (Mnemonic for deterioration of Endotracheal Intubation)

Displacement

Tube may be displaced out of the trachea or advanced into the right or left main bronchus. Use care with uncuffed ET tubes when moving your patient as they are easily displaced.

Obstruction

Check for kinks or secretions in tube. Prior to suctioning your patient, you want to hyper-oxygenate them, not hyperventilate. Then suction on the way out for now more than 10 seconds.

Pneumothorax

Tension pneumothorax is an accumulation of air under pressure in the pleural space. It is treated with needle decompression.

Equipment

Treat the patient not the equipment. Assist ventilations using a BVM, check your circuits.

Shock:

Compensated – **normotensive** with signs of *inadequate tissue perfusion*.

Decompensated (hypotensive) – blood pressure lower than 5th percentile:

- 1-12 months < 70,
- 1-10 years < 70 + (age in years x 2)
- >10 years < 90

Hypovolemic – (hemorrhagic or non-hemorrhagic) This is the most common type of shock in pediatric patients. May be caused by intravascular or extravascular loss. It is characterized by impaired perfusion that will rapidly progress to cardiac arrest if untreated.

Signs: quiet tachypnea, weak peripheral pulses, pale/cool skin, delayed cap refill

Management: 20 ml/kg NS/LR boluses, consider colloid, control bleeding, and transfuse PRBCs as indicated

Distributive – (septic, anaphylactic, neurogenic) Characterized by reduced SVR, maldistribution of blood volume/blood flow. Hypoxic tissues generate lactic acid, leading to metabolic acidosis.

Signs: normal to increased respiratory effort, crackles, bounding or weak pulses, warm or cool skin

Management: rapid fluid bolus, expanding extravascular volume. Consider vasopressor, Epi, Albuterol, antihistamines

Cardiogenic: - (brady/tachyarrhythmia, other: myocarditis, cardiomyopathy, poisoning, injury due to trauma) Characterized by reduced cardiac output secondary to pump failure or abnormal cardiac function.

Signs: labored respiratory effort, crackles, grunting, weak pulses, pale/cool skin

Management: manage arrhythmia, 5 to 10 ml/kg NS/LR bolus with frequent assessment of lung sounds, inotropic and/or vasoactive infusion, antidote for poisoning.

Obstructive: - (tension pneumothorax, cardiac tamponade, pulmonary embolism, ductal-dependent LV outflow obstruction). Refers to conditions that physically impair blood flow, limiting venous return to the heart or limit pumping of blood to the heart. **Decreased Cardiac Output

Signs: labored respiratory effort, crackles, grunting, weak pulses, pale/cool skin

Management: needle decompression, pericardiocentesis, fluid bolus, thrombolytics, anticoagulants, prostaglandin E1

Pediatric Respiratory Distress, Respiratory Failure, & Respiratory Arrest

Principles

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Updates

Pediatric Respiratory Distress, Respiratory Failure, & Respiratory Arrest

Introduction

Respiratory Distress

Respiratory distress, failure and arrest are part of the continuum of respiratory problems generating hypoxia in a child. Respiratory emergencies are one of the commonest reasons for pre-hospital emergency calls, and generate understandable anxiety in the child, and for the parents.

Respiratory distress is characterized by a child's response to inadequate gas exchange in the lungs resulting from any condition that compromises oxygenation and ventilation.

Respiratory distress signs include: Raised respiratory rate, increased work of breathing, retractions, use of accessory muscles, including nasal flaring, and breathing may be noisy (grunting, wheezing, stridor).

Airway obstruction progresses more quickly in children due to the small size of their airways and relative elasticity of the supporting tissues. When a child with respiratory distress and increased work of breathing develops an altered appearance (quieter /less agitated/sleepy) and slow (or normal) respiratory rate consider the likelihood of respiratory failure beginning. These changes can be due to hypoxia and/or hypercarbia.

Respiratory Failure

Respiratory failure occurs when a child is no longer able to compensate sufficiently and inadequate oxygenation and ventilation result in hypoxia.

Respiratory failure signs now include an abnormal appearance (agitation initially, lethargy and decreased conscious level, pallor and cyanosis as failure progresses). Respiratory rate and work of breathing are increased at first but decrease as the child's condition becomes more severe, often associated with the ominous sign of bradycardia.

Careful assessment and intervention in cases of actual or impending respiratory failure can prevent the progression to respiratory arrest in many situations.

Beware of the child with a "normal" respiratory rate in the setting of markedly decreased air entry or significant wheeze or obstruction. This child is actually in respiratory failure.

Respiratory Arrest

Respiratory arrest is present when there is no effective breathing. Respiratory arrest is the most common event precipitating cardiac arrest in a child.

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Capillary Refill Time

CRT assessment advised as part of primary circulation assessment

Capillary refill should occur within 2 seconds

Frequent causes of sluggish, delayed or prolonged capillary refill include:

- Dehydration
- Shock
- Hypothermia

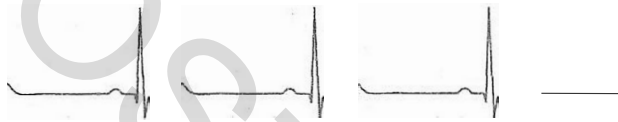
Shock can be present despite a normal CRT

Children with emergency signs, CRT greater than 3 seconds, require immediate treatment to avert death

CRT <3 seconds, check for a pulse

PALS Study Guide 2020 Guidelines

Cardiac Rhythms

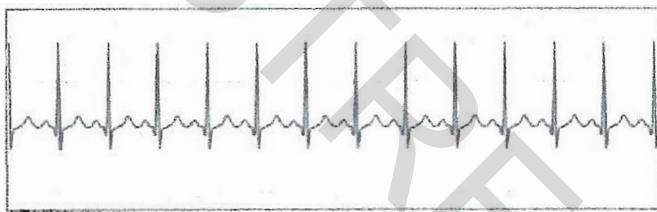


Normal Sinus Rhythm

Acceptable rate range varies according to age

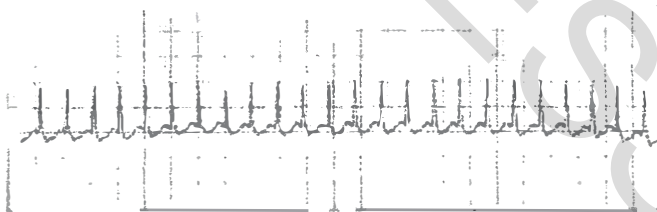
Sinus Bradycardia

Most common, usually Resp/oxygen related. If patient is compromised and not an immediate Respiratory fix, start CPR. Epi is the first drug for Pediatric patients



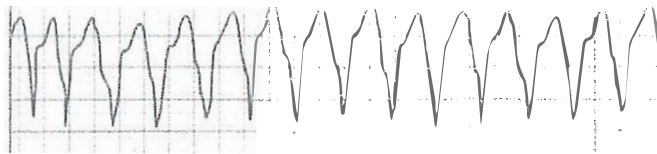
Sinus Tachycardia

Response to fever, pain, dehydration, physical exertion. Corrected by treating the underlying cause



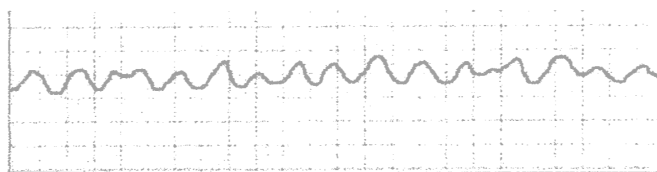
Supraventricular Tachycardia

HR greater than 220 in Infants, and 180 in Children. P wave can be absent or abnormal, rate does not vary with activity. If stable, consider Vagal Maneuvers but do not waist time if unstable. Adenosine or Synchronized Cardioversion



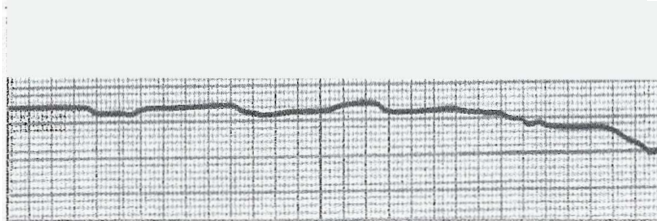
Ventricular Tachycardia

Always verify if pulse is present. if so, use the Tachycardia Algorithm, wide complex. If no pulse, use the Cardia Arrest Algorithm. Shockable Rhythm (defib), Meds: Epi and Amiodarone (or Lidocaine) if refractory



Ventricular Fibrillation

As with Pulseless V-tach, Shockable Rhythm (defib), Meds: Epi and Amiodarone (or Lidocaine) if refractory



Asystole

High Quality CPR with minimal interruptions. Meds: Epi

PEA: Any Organized Rhythm without a PULSE