PALS
Algorithms

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PALS Systematic Approach Algorithm

The PALS Systematic Approach Algorithm outlines the approach to caring for a critically ill or injured child.

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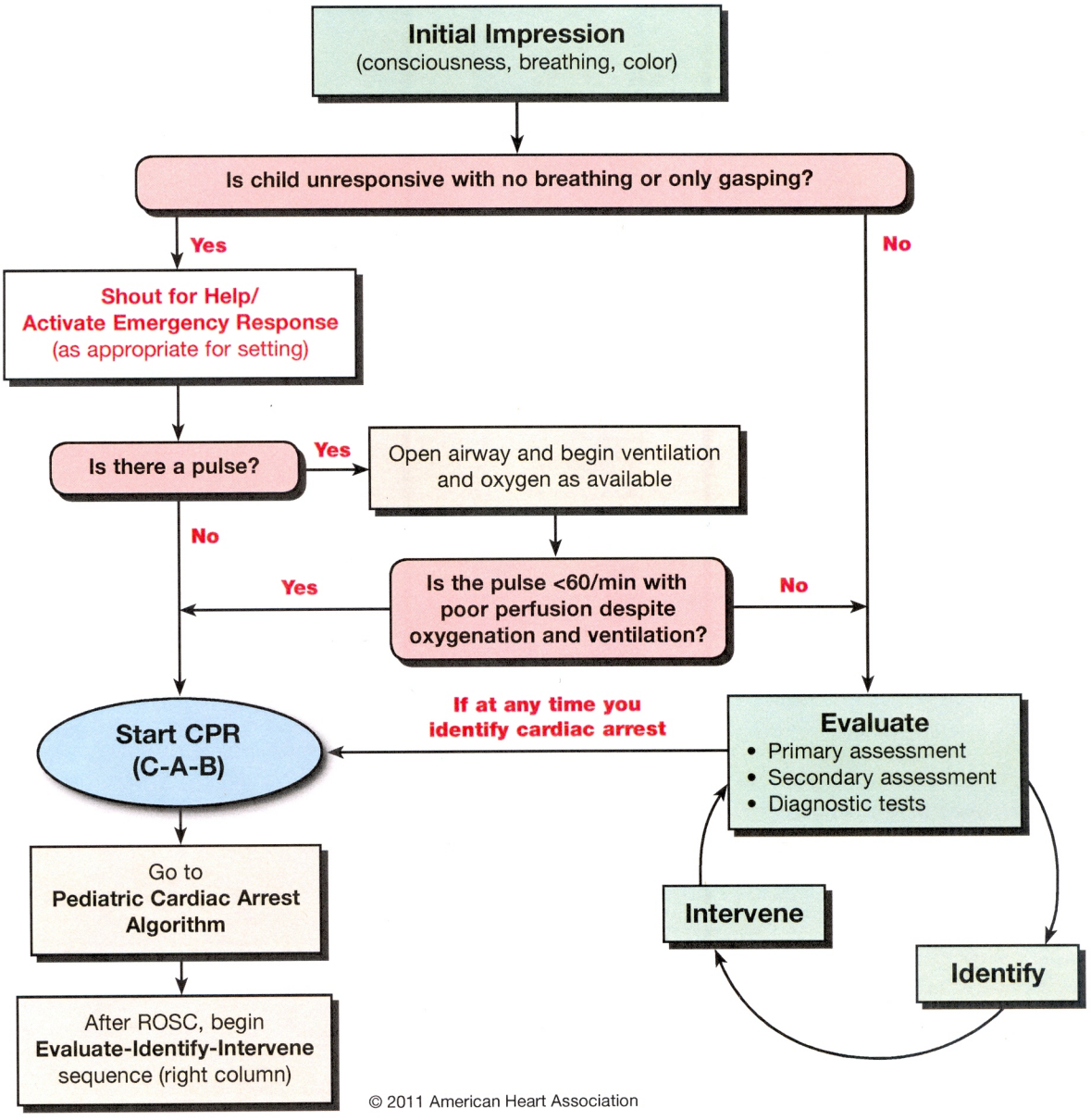

Management of Shock Flowchart

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Management of Shock Flowchart

- Oxygen
- Pulse oximetry
- ECG monitor
- IV/IO access
- BLS as indicated
- Point-of-care glucose testing

Hypovolemic Shock

Specific Management for Selected Conditions

Nonhemorrhagic	Hemorrhagic
• 20 mL/kg NS/LR bolus, repeat as needed • Consider colloid	• Control external bleeding • 20 mL/kg NS/LR bolus, repeat 2 or 3× as needed • Transfuse PRBCs as indicated

Distributive Shock

Specific Management for Selected Conditions

Septic	Anaphylactic	Neurogenic
Management Algorithm: • Septic Shock	• IM epinephrine (or autoinjector) • Fluid boluses (20 mL/kg NS/LR) • Albuterol • Antihistamines, corticosteroids • Epinephrine infusion	• 20 mL/kg NS/LR bolus, repeat PRN • Vasopressor

Cardiogenic Shock

Specific Management for Selected Conditions

Bradyarrhythmia/Tachyarrhythmia	Other (eg, CHD, Myocarditis, Cardiomyopathy, Poisoning)
Management Algorithms: • Bradycardia • Tachycardia With Poor Perfusion	• 5 to 10 mL/kg NS/LR bolus, repeat PRN • Vasoactive infusion • Consider expert consultation

Obstructive Shock

Specific Management for Selected Conditions

Ductal-Dependent (LV Outflow Obstruction)	Tension Pneumothorax	Cardiac Tamponade	Pulmonary Embolism
• Prostaglandin E_1 • Expert consultation	• Needle decompression • Tube thoracostomy	• Pericardiocentesis • 20 mL/kg NS/LR bolus	• 20 mL/kg NS/LR bolus, repeat PRN • Consider thrombolytics, anticoagulants • Expert consultation

Recognition of Shock Flowchart

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	Clinical Signs	Hypovolemic Shock	Distributive Shock	Cardiogenic Shock	Obstructive Shock
A	Patency	Airway open and maintainable/not maintainable			
B	Respiratory rate	Increased			
	Respiratory effort	Normal to increased		Labored	
	Breath sounds	Normal	Normal (± crackles)	Crackles, grunting	
C	Systolic blood pressure	**Compensated Shock → Hypotensive Shock**			
	Pulse pressure	Narrow	Variable	Narrow	
	Heart rate	Increased			
	Peripheral pulse quality	Weak	Bounding or weak	Weak	
	Skin	Pale, cool	Warm or cool	Pale, cool	
	Capillary refill	Delayed	Variable	Delayed	
	Urine output	Decreased			
D	Level of consciousness	Irritable early Lethargic late			
E	Temperature	Variable			

Management of Respiratory Emergencies Flowchart

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Management of Respiratory Emergencies Flowchart

- Airway positioning
- Suction as needed
- Oxygen
- Pulse oximetry
- ECG monitor (as indicated)
- BLS as indicated

Upper Airway Obstruction
Specific Management for Selected Conditions

Croup	Anaphylaxis	Aspiration Foreign Body
• Nebulized epinephrine • Corticosteroids	• IM epinephrine (or autoinjector) • Albuterol • Antihistamines • Corticosteroids	• Allow position of comfort • Specialty consultation

Lower Airway Obstruction
Specific Management for Selected Conditions

Bronchiolitis	Asthma
• Nasal suctioning • Bronchodilator trial	• Albuterol ± ipratropium • Corticosteroids • Subcutaneous epinephrine • Magnesium sulfate • Terbutaline

Lung Tissue Disease
Specific Management for Selected Conditions

Pneumonia/Pneumonitis Infectious Chemical Aspiration	Pulmonary Edema Cardiogenic or Noncardiogenic (ARDS)
• Albuterol • Antibiotics (as indicated)	• Consider noninvasive or invasive ventilatory support with PEEP • Consider vasoactive support • Consider diuretic

Disordered Control of Breathing
Specific Management for Selected Conditions

Increased ICP	Poisoning/Overdose	Neuromuscular Disease
• Avoid hypoxemia • Avoid hypercarbia • Avoid hyperthermia	• Antidote (if available) • Contact poison control	• Consider noninvasive or invasive ventilatory support

Recognition of Respiratory Problems Flowchart

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Signs of Respiratory Problems

	Clinical Signs	Upper Airway Obstruction	Lower Airway Obstruction	Lung Tissue Disease	Disordered Control of Breathing
A	Patency	Airway open and maintainable/not maintainable			
B	Respiratory Rate/Effort	Increased			Variable
B	Breath Sounds	Stridor (typically inspiratory) Barking cough Hoarseness	Wheezing (typically expiratory) Prolonged expiratory phase	Grunting Crackles Decreased breath sounds	Normal
B	Air Movement	Decreased			Variable
C	Heart Rate	Tachycardia (early) Bradycardia (late)			
C	Skin	Pallor, cool skin (early) Cyanosis (late)			
D	Level of Consciousness	Anxiety, agitation (early) Lethargy, unresponsiveness (late)			
E	Temperature	Variable			

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Identification of Respiratory Problems by Severity

	Respiratory Distress → Respiratory Failure
A	Open and maintainable ⇨ Not maintainable
B	Tachypnea ⇨ Bradypnea to apnea
B	Work of breathing (nasal flaring/retractions) Increased effort ⇨ Decreased effort ⇨ Apnea
B	Good air movement ⇨ Poor to absent air movement
C	Tachycardia ⇨ Bradycardia
C	Pallor ⇨ Cyanosis
D	Anxiety, agitation ⇨ Lethargy to unresponsiveness
E	Variable temperature

Pediatric Cardiac Arrest Algorithm

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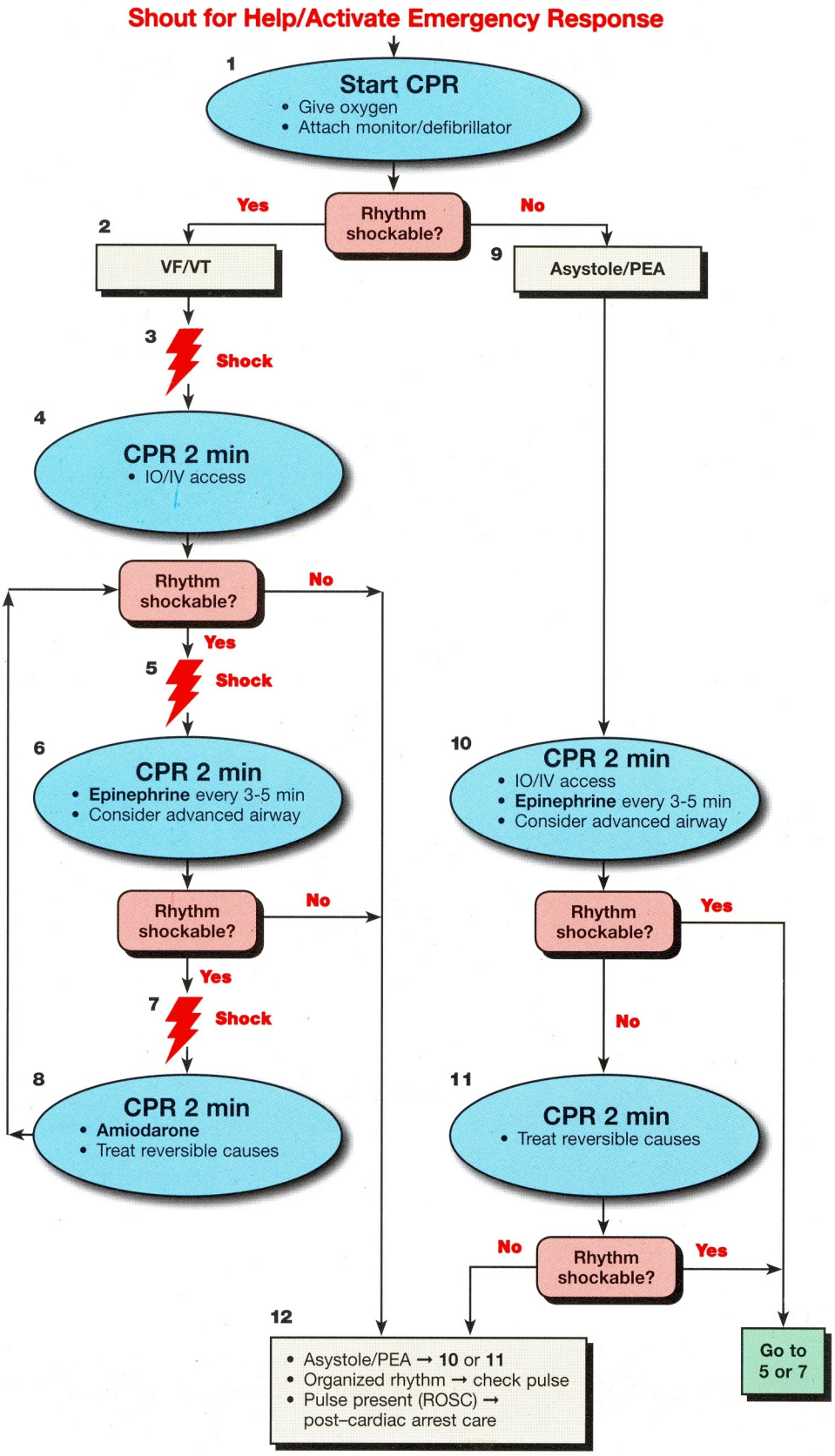

Doses/Details

CPR Quality
- Push hard (≥1/3 of anterior-posterior diameter of chest) and fast (at least 100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 15:2 compression-ventilation ratio. If advanced airway, 8-10 breaths per minute with continuous chest compressions

Shock Energy for Defibrillation
First shock 2 J/kg, second shock 4 J/kg, subsequent shocks ≥4 J/kg, maximum 10 J/kg or adult dose.

Drug Therapy
- **Epinephrine IO/IV Dose:** 0.01 mg/kg (0.1 mL/kg of 1:10 000 concentration). Repeat every 3-5 minutes. If no IO/IV access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of 1:1000 concentration).
- **Amiodarone IO/IV Dose:** 5 mg/kg bolus during cardiac arrest. May repeat up to 2 times for refractory VF/pulseless VT.

Advanced Airway
- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement
- Once advanced airway in place give 1 breath every 6-8 seconds (8-10 breaths per minute)

Return of Spontaneous Circulation (ROSC)
- Pulse and blood pressure
- Spontaneous arterial pressure waves with intra-arterial monitoring

Reversible Causes
- **H**ypovolemia
- **H**ypoxia
- **H**ydrogen ion (acidosis)
- **H**ypoglycemia
- **H**ypo-/hyperkalemia
- **H**ypothermia
- **T**ension pneumothorax
- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- **T**hrombosis, coronary

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Pediatric Bradycardia With a Pulse and Poor Perfusion Algorithm

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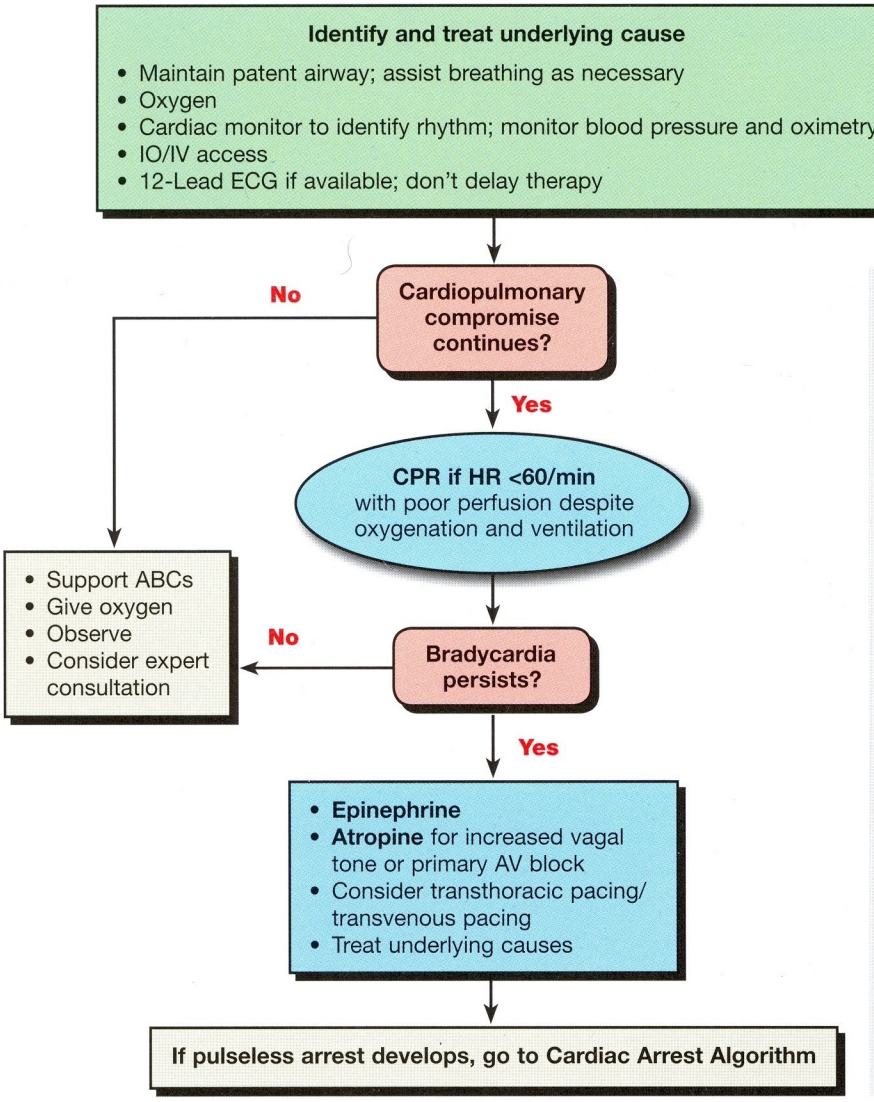

Cardiopulmonary Compromise

- Hypotension
- Acutely altered mental status
- Signs of shock

Doses/Details

Epinephrine IO/IV Dose: 0.01 mg/kg (0.1 mL/kg of 1:10 000 concentration). Repeat every 3-5 minutes. If IO/IV access not available but endotracheal (ET) tube in place, may give ET dose: 0.1 mg/kg (0.1 mL/kg of 1:1000).

Atropine IO/IV Dose: 0.02 mg/kg. May repeat once. Minimum dose 0.1 mg and maximum single dose 0.5 mg.

Pediatric Tachycardia With a Pulse and Adequate Perfusion Algorithm

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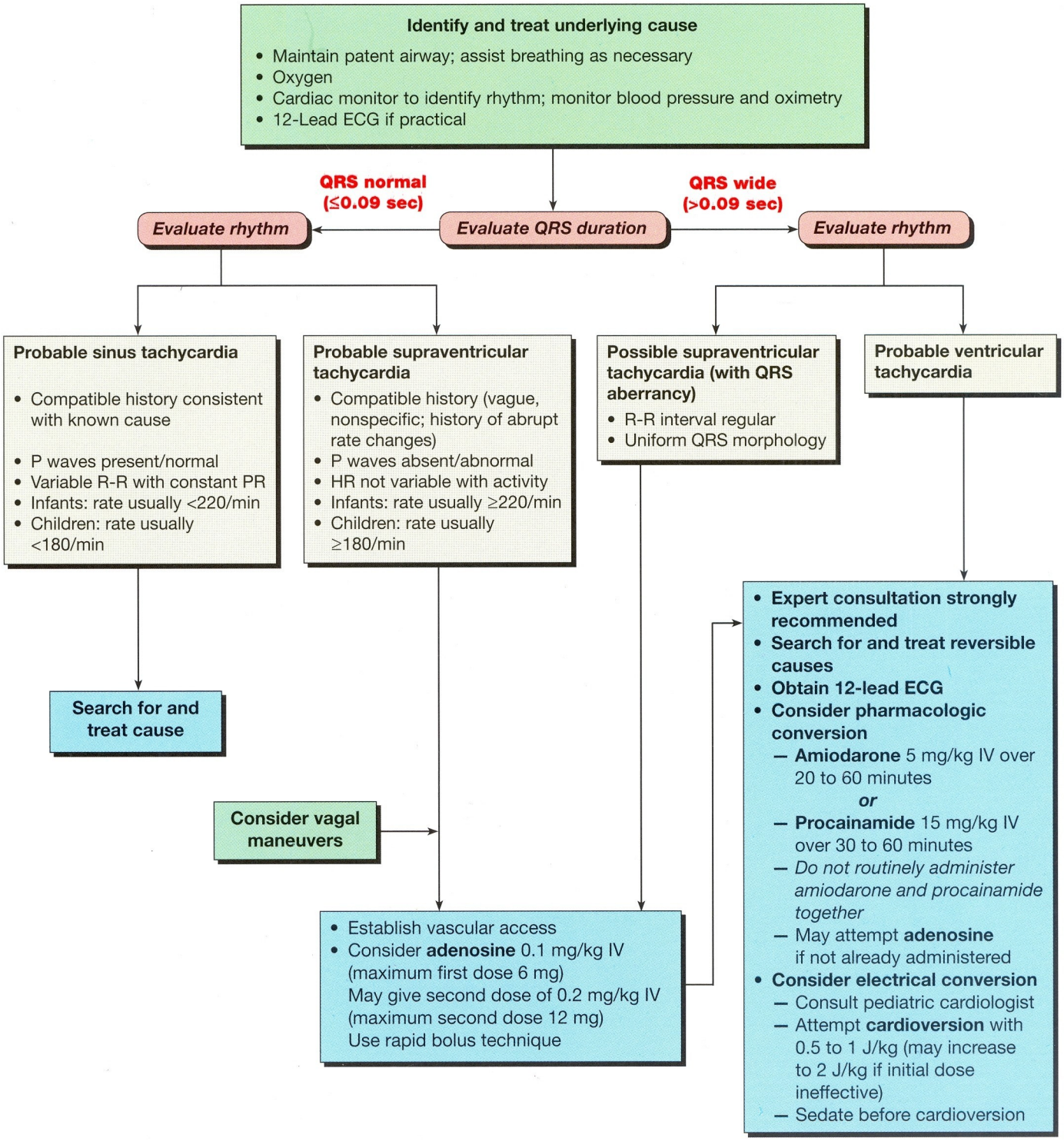

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Pediatric Tachycardia With a Pulse and Poor Perfusion Algorithm

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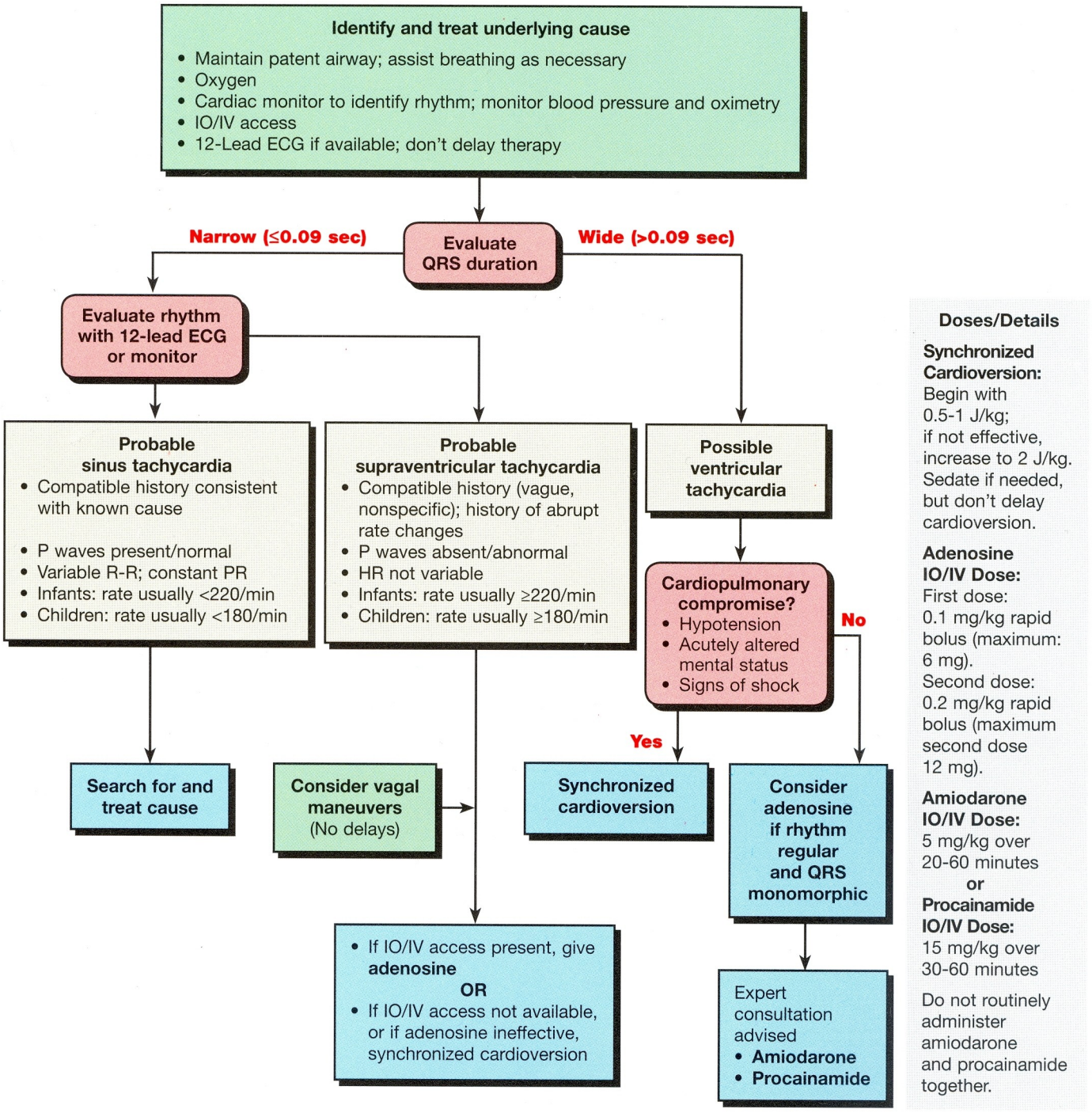

Doses/Details

Synchronized Cardioversion:
Begin with 0.5-1 J/kg; if not effective, increase to 2 J/kg. Sedate if needed, but don't delay cardioversion.

Adenosine IO/IV Dose:
First dose: 0.1 mg/kg rapid bolus (maximum: 6 mg).
Second dose: 0.2 mg/kg rapid bolus (maximum second dose 12 mg).

Amiodarone IO/IV Dose:
5 mg/kg over 20-60 minutes
or
Procainamide IO/IV Dose:
15 mg/kg over 30-60 minutes

Do not routinely administer amiodarone and procainamide together.

Pediatric Postresuscitation Care

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Pediatric Advanced Life Support

Management of Shock After ROSC

Optimize Ventilation and Oxygenation
- Titrate F_{IO_2} to maintain oxyhemoglobin saturation 94%-99%; if possible, wean F_{IO_2} if saturation is 100%
- Consider advanced airway placement and waveform capnography

Assess for and Treat Persistent Shock
- Identify, treat contributing factors.*
- Consider 20 mL/kg IV/IO boluses of isotonic crystalloid. Consider smaller boluses (eg, 10 mL/kg) if poor cardiac function suspected.
- Consider the need for inotropic and/or vasopressor support for fluid-refractory shock.

***Possible Contributing Factors**

Hypovolemia
Hypoxia
Hydrogen ion (acidosis)
Hypoglycemia
Hypo-/hyperkalemia
Hypothermia
Tension pneumothorax
Tamponade, cardiac
Toxins
Thrombosis, pulmonary
Thrombosis, coronary
Trauma

Hypotensive Shock
- Epinephrine
- Dopamine
- Norepinephrine

Normotensive Shock
- Dobutamine
- Dopamine
- Epinephrine
- Milrinone

- Monitor for and treat agitation and seizures
- Monitor for and treat hypoglycemia
- Assess blood gas, serum electrolytes, calcium
- If patient remains comatose after resuscitation from cardiac arrest, consider therapeutic hypothermia (32°C-34°C)
- Consider consultation and patient transport to tertiary care center

Estimation of Maintenance Fluid Requirements

- **Infants <10 kg:** 4 mL/kg per hour

  Example: For an 8-kg infant, estimated maintenance fluid rate
  = 4 mL/kg per hour × 8 kg
  = 32 mL per hour

- **Children 10-20 kg:** 4 mL/kg per hour for the first 10 kg + 2 mL/kg per hour for each kg above 10 kg

  Example: For a 15-kg child, estimated maintenance fluid rate
  = (4 mL/kg per hour × 10 kg)
  + (2 mL/kg per hour × 5 kg)
  = 40 mL/hour + 10 mL/hour
  = 50 mL/hour

- **Children >20 kg:** 4 mL/kg per hour for the first 10 kg + 2 mL/kg per hour for kg 11-20 + 1 mL/kg per hour for each kg above 20 kg.

  Example: For a 28-kg child, estimated maintenance fluid rate
  = (4 mL/kg per hour × 10 kg)
  + (2 mL/kg per hour × 10 kg)
  + (1 mL/kg per hour × 8 kg)
  = 40 mL per hour + 20 mL per hour
  + 8 mL per hour
  = 68 mL per hour

Following initial stabilization, adjust the rate and composition of intravenous fluids based on the patient's clinical condition and state of hydration. In general, provide a continuous infusion of a dextrose-containing solution for infants. Avoid hypotonic solutions in critically ill children; for most patients use isotonic fluid such as normal saline (0.9% NaCl) or lactated Ringer's solution with or without dextrose, based on the child's clinical status.