

Diagnostic Approach to Pediatric Emergencies

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Aims

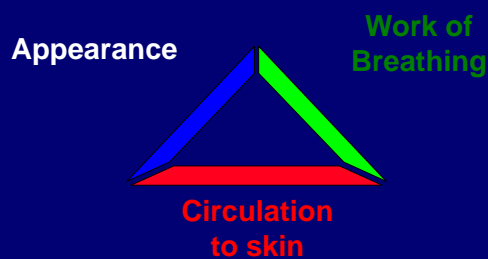
- Pediatric Assessment
- Respiratory Emergencies
- Shock
- Cardiac Rhythm Disturbances
- Emergency Procedures

Pediatric Assessment

Pediatric assessment

- Initial assessment
 - PAT
 - ABCDE
- Cardiovascular assessment
 - Vital signs
 - End-organ perfusion

Pediatric Assessment Triangle



Appearance

- **T**one
- **I**nteractiveness
- **C**onsolability
- **L**ook/Gaze
- **S**peech/Cry



Work of Breathing

- Abnormal airway sounds
- Abnormal positioning
- Retractions
- Nasal flaring
- Head bobbing



Circulation to Skin

- Pallor
- Mottling
- Cyanosis



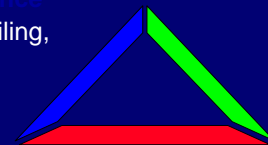
Case Study 1: “Cough, Difficulty Breathing”

- One-year-old boy presents with complaint of cough, difficulty breathing.
- Past history is unremarkable. He has had nasal congestion, low grade fever for 2 days.

Pediatric Assessment Triangle

Appearance
Alert, smiling,
nontoxic

Breathing
Audible
inspiratory
stridor at rest



Circulation
Pink

Questions

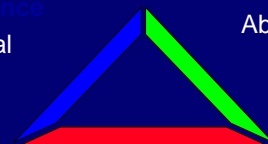
What information does the PAT tell you about this patient?

What is your general impression?

Pediatric Assessment Triangle: Respiratory Distress

Appearance
Normal

Breathing
Abnormal



Circulation
Normal

General Impression

- Stable
- Respiratory distress
- Respiratory failure
- Shock (compensated/decompensated)
- CNS or Endocrine dysfunctions
- Cardiopulmonary failure/arrest

TABLE 2-7 PAT Configurations and Emergency Etiologies

Appearance	Work of Breathing	Circulation to Skin	General Impression of Physiologic State	Examples of Etiologies
Abnormal	Normal	Normal	Primary brain dysfunction Systemic problem	Shaken baby Brain injury Sepsis Hypoglycemia Intoxication
Normal	Abnormal	Normal	Respiratory distress	Mild asthma Bronchiolitis Croup Community-acquired pneumonia Foreign body aspiration
Abnormal	Abnormal	Normal	Respiratory failure	Severe asthma Pulmonary contusion Penetrating chest injury
Normal	Normal	Abnormal	Compensated shock	Diarrhea External blood loss
Abnormal	Normal	Abnormal	Decompensated shock	Severe gastroenteritis Major burn Major blunt injury
Abnormal	Abnormal	Abnormal	Cardiopulmonary failure	Penetrating abdominal injury Cardiopulmonary arrest

Adapted from: Dieckmann R, Brownstein D, Gausche-Hill M, eds. Pediatric Education for Prehospital Professionals. Sudbury, MA: Jones and Bartlett Publishers, American Academy of Pediatrics; 2000:30-37.

Case Progression/Outcome

- Initial assessment: Respiratory distress with upper airway obstruction
- Initial treatment priorities:
 - Leave in a position of comfort.
 - Obtain oxygen saturation.
 - Provide oxygen as needed.
 - Begin specific therapy.

Initial assessment-ABCDE

- Airway
- Breathing
- Circulation
- Disability
- Exposure

Airway

- Manual airway opening maneuvers: Head tilt-chin lift, jaw thrust
- Suction: Can result in dramatic improvement in infants
- Age-specific obstructed airway support:
 - <1 year: Back blow/chest thrust
 - >1 year: Abdominal thrust
- Advanced airway techniques

Breathing: Respiratory Rate

Age	Respiratory Rate
Infant	30 to 60
Toddler	24 to 40
Preschooler	22 to 34
School-aged child	18 to 30
Adolescent	12 to 16

- Slow or fast respirations are worrisome.

Breathing: Auscultation

- Listen with stethoscope over midaxillary line and above sternal notch
 - Stridor: Upper airway obstruction
 - Wheezing: Lower airway obstruction
 - Grunting: Poor oxygenation; pneumonia, drowning, pulmonary contusion
 - Crackles: Fluid, mucus, blood in airway
 - Decreased/absent breath sounds: Obstruction

Circulation: Heart Rate

Age	Normal Heart Rate
Infant	100 to 160
Toddler	90 to 150
Preschooler	80 to 140
School-aged child	70 to 120
Adolescent	60 to 100

Circulation

- Pulse quality: Palpate central and peripheral pulses
- Skin temperature: Reverse thermometer sign
- Capillary refill
- Blood pressure: Minimum BP
= $70 + (2 \times \text{age in years})$

Hypotension (SBP, mmHg)

- Newborn (0-28 days): < 60
- Infant: < 70
- Child (1-10): $< 70 + (\text{age} \times 2)$
- Child (≥ 10): < 90



Pediatric Vital signs

	HR	RR	BP
0-1 y/o	100-160	30-60	60-70
1-6 y/o	~140	20-40	$70 + \text{Age} \times 2$
6-12 y/o	~120	15-30	$70 + \text{Age} \times 2$
>12 y/o	60-100	20	> 90

Disability

- Quick neurologic exam
- AVPU scale:
 - Alert
 - Verbal: Responds to verbal commands
 - Painful: Responds to painful stimulus
 - Unresponsive
- (Pediatric) Glasgow Coma Scale

Exposure

- Proper exposure is necessary to evaluate physiologic function and identify anatomic abnormalities.
- Maintain warm ambient environment and minimize heat loss.
- Monitor temperature.
- Warm IV fluids.

End-organ perfusion

- **Skin:** temperature, color, capillary refilling time
- **Brain:** level of consciousness
- **Kidney:** urine output

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Respiratory Emergencies

Case Study 1

- Mother of 13-month-old boy found him choking and gagging next to container of spilled nuts.
- Paramedics noted appearance is alert; work of breathing is increased with audible stridor; subcostal retractions; color is normal.

Initial Assessment (1 of 2)

PAT:

- Normal appearance, abnormal breathing, normal circulation

Vital signs:

- HR 160, RR 60, BP 88/56, T 37.1°C, O₂ sat 93%, Wt 11 kg

Question

What is your general impression of this patient?

General Impression

- Respiratory distress:
 - Upper airway obstruction
 - Foreign body aspiration

What are your initial management priorities?

Initial Assessment (2 of 2)

- A:** Stridor
- B:** Tachypneic with retractions, reduced tidal volume
- C:** Color is normal, skin is warm and dry, pulse is rapid but strong and regular.
- D:** Alert with no focal neurologic signs; GCS 15
- E:** No obvious signs of injury

Management Priorities

- Patient is brought to monitored bed and allowed to remain in position of comfort.
- Supplemental oxygen is provided.
- IV access is deferred to avoid agitation.
- Specialists are contacted.

Your First Clue: Foreign Body Aspiration

- A history of choking is the most reliable predictor of FB aspiration.
- Other signs and symptoms include:
 - Upper airway: Stridor, respiratory or cardiopulmonary arrest
 - Lower airway: Coughing, wheezing, retractions, decreased breath sounds, cyanosis

Discussion: Foreign Body Aspiration

- Background:
 - 150-300 fatalities in young children each year.
 - 2/3 of cases are in children 1-2 years of age.

Background: Foreign Body Aspiration (1 of 2)

- Food items are the most commonly aspirated FB.
- Balloons are the most common FB to result in death.



Background: Foreign Body Aspiration (2 of 2)

- Foreign objects can be lodged in the upper or lower airway, or esophagus.
- Differences in the pediatric airway make evaluation and management of foreign body aspiration challenging.

TABLE 3-1 Comparison of Infant and Adult Airways¹⁻³

	Infant	Adult
Head	Large prominent occiput resulting in sniffing position	Flat occiput
Tongue	Relatively larger	Relatively smaller
Larynx	Cephalad position, opposite C2 and C3 vertebrae	Opposite C4 to C6
Epiglottis	Ω shaped, soft	Flat, flexible
Vocal cords	Short, concave	Horizontal
Smallest diameter	Cricoid ring, below cords	Vocal cords
Cartilage	Soft, less calcified	Firm, calcified
Lower airway	Smaller, less developed	Larger, more cartilage

Diagnostic Studies

- Radiology
 - Radiopaque FBs are seen in about 15% of cases.
 - Other findings seen in lower airway FB aspiration on chest radiograph
 - Air trapping/hyperinflation
 - Pulmonary consolidation
 - Barotrauma

Radiology

- In this chest radiograph, FB aspiration is suggested as the left side of the chest is hyperlucent from air trapping.



Management (1 of 6)

- Upper airway FB:
 - If patient is able to cough or speak:
 - Leave in a position of comfort.
 - Provide supplemental oxygen.
 - Consider heliox therapy
 - Priority to get patient to operating room for removal

Management (2 of 6)

- Upper airway:
 - With severe partial or complete airway obstruction, management depends on age.
 - Management options can be divided into basic life support (BLS) and advanced life support (ALS).

Management (3 of 6)

- BLS:
 - Infant: 5 back blows/5 chest thrusts



Management (4 of 6)

- BLS:
 - Child: 5 abdominal thrusts



Management (5 of 6)

- ALS:
 - Laryngoscopy and removal with Magill forceps



Management (6 of 6)

- Lower airway FB:
 - Heliox may be tried as a temporizing measure prior to removal for patients in severe respiratory distress.
 - Bronchoscopy and removal of FB in operating room
 - FB retrieval rate approaches 100%.

Case Progression/Outcome

- Patient was taken to operating room where rigid bronchoscopy was performed and a peanut was removed from the subglottic airway.

Case Study 2

- 15-month-old boy with a history of cold for 2 days develops a barking cough.
- He tracks you with his gaze as you approach.
- He has stridor at rest, retractions, and has cyanosis around his lips.

Initial Assessment (1 of 2)

PAT:

- Normal appearance, abnormal breathing, normal circulation

Vital signs:

- HR 180, RR 60, T 38.4°C, O₂ sat 91% on blow-by oxygen, Wt 10 kg

Question

What is your general impression of this patient?

General Impression

- Respiratory distress:
 - Upper airway obstruction
 - Croup

What are your initial management priorities?

Initial Assessment (2 of 2)

- A:** Stridor at rest
- B:** Tachypnea, retractions
- C:** Slight cyanosis around the lips, otherwise color is normal, capillary refill <2 seconds, skin warm and dry, pulse strong and rapid
- D:** Alert, GCS 15
- E:** No signs of injury, no rash

Management Priorities

- Leave patient in a position of comfort.
- Place patient on cardiorespiratory monitor.
- Administer nebulized epinephrine.
- Administer corticosteroids IM.

Your First Clue: Croup

- Prodromal symptoms mimic upper respiratory infection.
- Fever is usually low grade (50%).
- Barky cough and stridor (90%) are common.
- Hoarseness and retractions may also occur.

Background: Croup

- Croup, or laryngotracheobronchitis, is common in infants and children.
 - Affects children 6 months to 6 years
 - Incidence 3-5/100 children
 - Peak in second year of life
 - Seasonal: Occurs in fall and early winter
 - Viral etiology most common: Parainfluenza virus

TABLE 3-5 Clinical Croup Score*

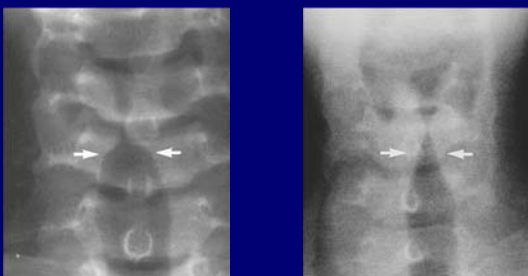
	0	1	2
Cyanosis	None	In room air	In 40% O ₂
Inspiratory breath sounds	Normal	Harsh with rhonchi	Delayed
Stridor	None	Inspiratory	Inspiratory and expiratory or stridor at rest
Cough	None	Hoarse cry	Bark
Retractions and flaring	None	Flaring and suprasternal retractions	Flaring and suprasternal retractions plus subcostal and intercostal retractions

*A score of ≥ 4 indicates moderately severe airway obstruction. A score of ≥ 7 , particularly when associated with PaCO_2 of ≥ 45 and PaO_2 of < 70 (in room air), indicates impending respiratory failure.

Diagnostic Studies

- The diagnosis of croup is made clinically.
- Routine laboratory or radiological studies are not necessary.
- Plain radiography of neck performed on cases in which diagnosis was in question may show a Steeple sign.

Steeple Sign



Differential Diagnosis: What Else?

- Epiglottitis (rare)
- Bacterial tracheitis
- Peritonsillar abscess
- Uvulitis
- Allergic reaction
- Foreign body aspiration
- Neoplasm

Management Options: Croup

- Humidified oxygen
 - Theoretical benefit – literature suggests NO significant benefit
- Steroids
 - Faster improvement with croup score, decrease in endotracheal intubation, and shorter hospital stays

Management Options: Croup

- Steroids
 - No significant difference in outcome between dexamethasone and budesonide
 - Dexamethasone
 - Doses 0.15-0.6 mg/kg PO or IM are effective.
 - Budesonide
 - Dose 2mg/2mL nebulized

Management Options: Croup

- Epinephrine
 - Begin epinephrine for signs of moderate to severe respiratory distress.
 - Racemic 0.05 mL/kg (max 0.5 mL)
 - L-epinephrine (1:1,000 solution) 0.5 mL/kg (max 5 mL)
 - Observe patients receiving epinephrine for a minimum of 3 hours before discharge.

Case Progression/Outcome

- 15-month-old patient received inhaled epinephrine and dexamethasone IM.
- He was observed in the ED for 3 hours.
- At the time of discharge, his respiratory rate was 40 breaths/min and O₂ sat was 97% on room air.

Stridor in children > 6 m/o

	Viral Croup	Bacterial Tracheitis	Epiglottitis	Peritonsillar Abscess	Retropharyngeal Abscess	Foreign Body Aspiration
Etiology	Parainfluenza viruses (occasionally respiratory syncytial virus and rhinovirus)	Staphylococcus aureus (most) <i>S. pneumoniae</i> <i>S. aureus</i> <i>H. influenzae</i>	Streptococcus pneumoniae <i>S. aureus</i> <i>S. aureus</i>	Polymicrobial <i>S. pyogenes</i>	Polymicrobial <i>S. pyogenes</i> <i>S. aureus</i>	Variable Foods Peanuts Sawdust
Age	6 mo–3 y old	3 mo–12 y old	All ages	10–18 y old (most)	6 mo–4 y old (most)	Any
Peak	1–2 y old	Mean, 5–8 y old	Classically 1–7 y old	6 mo–3 y old	Rare >4 years	6 mo–5 y old most common
Onset	1–3 d	2–7 d viral upper respiratory infection Suddenly worse over 8–12 h	Rapid, hours	Antecedent pharyngitis	Insidious over 2–3 d after an upper respiratory infection or local trauma	80% <3 years Immediate or delayed possible
Effect of positioning on symptoms	None	None	Worse supine Prefer erect, then forward	Worse supine	Neck stiffness and hyperextension	Usually none Location-Dependent
History	Inspiratory and expiratory Saw-tooth bark	Inspiratory and expiratory Usually	Inspiratory	Uncommon	Inspiratory when severe	Location-Dependent Often transient or local

Sign	Viral Croup	Bacterial Tracheitis	Epididymitis	Peritonsillar Abscess	Retropharyngeal Abscess	Foreign Body Aspiration
Onset	1-3 d	2-7 d w/ viral upper respiratory infection	Rapid, hours	Antecedent pharyngitis	Insidious over 2-3 d after an upper respiratory infection at local trauma	Immediate as observed event
Effect of positioning on symptoms	None	None	Worse supine	Worse supine	Neck stiffness and hyperextension	Usually none
Stridor	Inspiratory and expiratory	Inspiratory and expiratory	Inspiratory	Uncommon	Inspiratory when severe	Location-dependent
Cough	Squel-like bark	Usually	No	No	No	Often transient or positional
Voice	Hoarse	Usually normal	Muffled	Muffled	Often muffled	Location-dependent
Drinking	Not muffled	Possibly raspy	"Hot potato"	"Hot potato"	"Hot potato"	Primarily if at or above glottis
Dysphagia	Occasional	No	Yes	Often	Yes	Rare—often if esophageal
Endoscopic appearance	Subglottic narrowing "steeple"	Subglottic narrowing irregular tracheal margins	Enlarged epiglottis Thickened aryepiglottic folds	May see enlarged tonsillar soft tissue	Thickened bulging retropharyngeal soft tissue	Often normal Possible esophageal diverticuli
						Gill valve effect Segmental stenosis

Common pediatric respiratory emergency

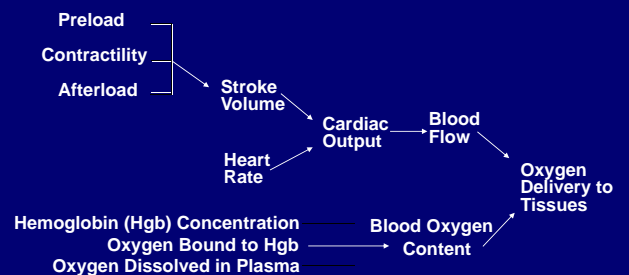
- Upper Airway
 - Croup
 - FB aspiration
 - Retropharyngeal abscess
 - Epiglottitis
 - Anaphylaxis
- Lower airway
 - Bronchiolitis
 - Asthma
 - pneumonia

Shock

Shock

- Inadequate tissue perfusion (delivery of oxygen and nutrients) to meet the metabolic demands of the body.

Pathophysiology of Shock



S/S

- **Early S/S:** Tachypnea, Tachycardia, Mottling or pallor skin, Prolonged capillary refilling time
- **Late S/S:** Altered consciousness, Hypotension, Respiratory failure, Oligouria, Cyanosis

Hypovolemic Shock

- Fluid loss:
 - Diarrhea, vomiting, anorexia, diuresis
 - Hemorrhage
- Resuscitation:
 - Fluid replacement
 - NS or LR 20 mL/kg bolus infusions, reassess, repeat as needed
 - Blood transfusion for excessive hemorrhage

Cardiogenic Shock

- Poor myocardial contractility or impaired ejection:
 - Cardiomyopathy, congenital heart disease, myocarditis, congestive heart failure, arrhythmia
- Resuscitation:
 - Fluid bolus (10 mL/kg) and reassess
 - Inotropes, pressors (e.g., dopamine, dobutamine, epinephrine)

Distributive Shock

- Inappropriate vasodilation with maldistribution of blood flow:
 - Anaphylactic shock, spinal cord injury, septic shock
 - “Warm shock”
- Resuscitation:
 - Vasoconstrictors (e.g., epinephrine)
 - Anaphylaxis treatment
 - Spinal cord injury treatment
 - Sepsis treatment

Septic Shock

- Elements of distributive shock, cardiogenic shock and hypovolemic shock:
 - Inappropriate vasodilation with a maldistribution of blood flow
 - Myocardial depression
 - Relative hypovolemia
- Resuscitation:
 - Fluid bolus
 - Pressors and inotropes
 - Antibiotics

Obstructive shock

- Tension pneumothorax/ Cardiac tamponade
- Resuscitation:
 - Fluid bolus
 - Emergency decompression

Compensated vs Decompensated


- Compensated:
 - Vital organs continue to be perfused by compensatory mechanisms.
 - Blood pressure is normal.
- Decompensated:
 - Compensatory mechanisms are overwhelmed and inadequate.
 - Hypotension, high mortality risk
- Aggressive treatment of early shock:
 - Halts progression to decompensated shock

Compensated Shock

Appearance
 Alert, anxious

Work of Breathing
 Tachypnea

Circulation
 tachycardia, decreased peripheral pulses, cool or pale skin

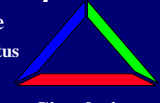


Decompensated Shock

Appearance
 Altered mental status

Work of Breathing
 Tachypnea, bradypnea

Circulation
 Tachycardia/ bradycardia, absent peripheral pulses, mottled/cyanotic skin



7-month-old boy

- Diarrhea and vomiting x 24 hrs
- Fever
- Poor intake
- Fussier than usual
- Decreased urine output: 1 wet diaper in 12 h

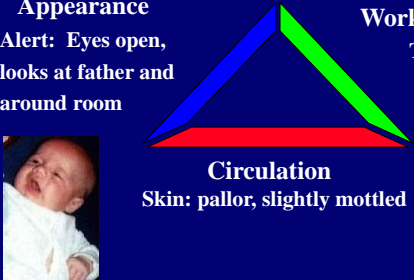


Initial assessment-PAT

Appearance
Alert: Eyes open,
looks at father and
around room

Work of Breathing
Tachypnea

Circulation
Skin: pallor, slightly mottled



What is general impression?

Compensated shock

Initial assessment-ABCDE

- Airway: patent
- Breathing: tachypnea; no stridor or wheezing, no retraction → **O2 delivery**
- Circulation: Cool; Capillary refilling time: 3-4 seconds → **IV & Monitor**
- Disability: alert
- Exposure: no wound

Vital signs

- HR 200; BP 74/35; RR 40; BT 37.3°C; weight 6 kg

What is your differentiate diagnosis and management priorities?

Differentiate diagnosis

- Hypovolemic shock
- The common causes
 - Acute enterocolitis
 - Hemorrhagic shock by trauma
 - DKA with dehydration

Management Priorities

- ABCDE
- O2/ IV/ Monitor
- Isotonic fluid resuscitation
 - 20 mL/kg NS rapid bolus
 - Reassessment
- Obtain laboratory studies and cultures

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Cardiac Rhythm Disturbances

Stable Versus Unstable

- Unstable rhythm require emergency therapy
 - Rhythm that may cause and deteriorate circulatory instability

Circulatory instability

- Compensated shock
- Decompensated shock (hypotension)
 - Poor end-organ perfusion
 - Altered consciousness
- Cardiopulmonary arrest

Assessment of cardiovascular function

- Assess ventilation, heart rate, end-organ perfusion, peripheral pulse, blood pressure
- Is cardiovascular instability present?
- Is CPR needed?

Rhythm groups by pulse rate

- Slow pulse rate = bradyarrhythmia
- Fast pulse rate = tachyarrhythmia
- Absent pulse = pulseless arrest = collapse rhythm

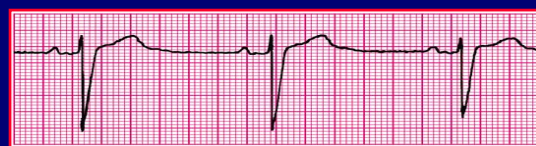
Definitions of rhythm groups

Rate	Infant	Child
Fast	>220	>180
Slow	<80	<60

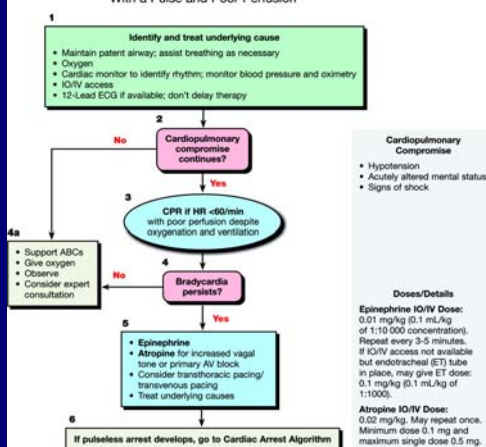
Assessment of cardiac rhythm groups

- Is the pulse rate slow, fast, or absent ?
- Is perfusion compromised ?
- Are the ventricular complexes wide or narrow ?
- Is there a diagnostic pattern to the ECG ?

Diagnosis?



Pediatric Bradycardia With a Pulse and Poor Perfusion



Fast pulse- narrow ventricular complex- SVT vs ST

- **ST**
 - History compatible with ST (eg, fever, dehydration, pain)
 - P waves present/ normal
 - Heart rate often varies with activity
 - Infant: HR < 220 bpm
 - Child: HR < 180 bpm
- **SVT**
 - History incompatible with ST
 - P waves absent/ abnormal
 - Heart rate does not vary with activity
 - Infant: HR > 220 bpm
 - Child: HR > 180 bpm

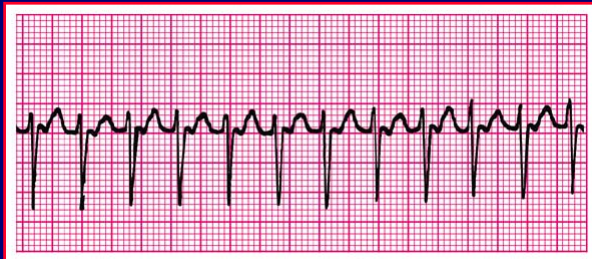
Management of SVT

- Poor perfusion
 - Vagal maneuvers
 - Immediate electrical cardioversion (0.5-1J/Kg, up to 2J/Kg)
 - Chemical cardioversion (adenosine)
- Adequate perfusion
 - Vagal maneuvers
 - Chemical cardioversion
 - Electrical cardioversion

Sinus Tachycardia



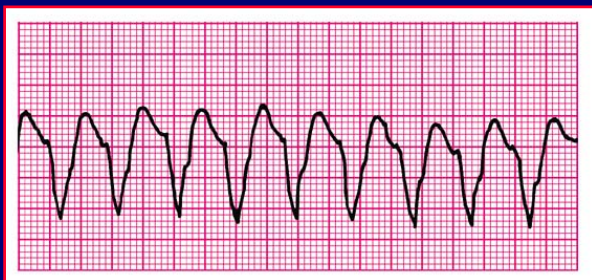
Paroxysmal Supraventricular Tachycardia



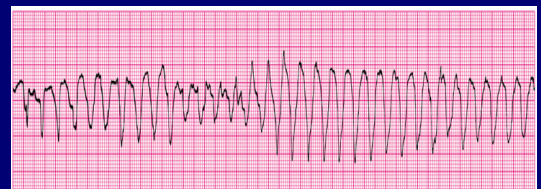
Ventricular tachycardia

- Monomorphic VT
- Polymorphic VT (Torsades de Pointes)

Ventricular tachycardia



Polymorphic VT

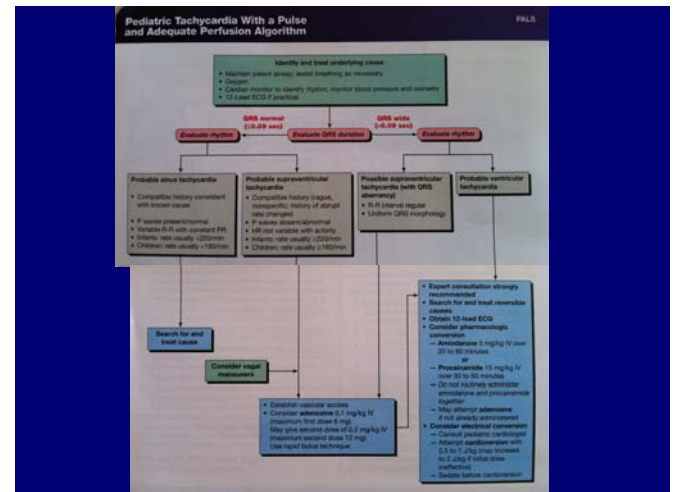
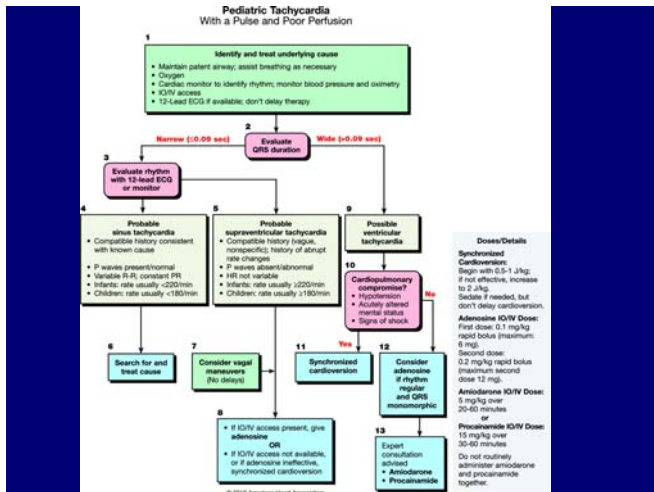


Management of monomorphic VT

- Poor perfusion
 - Synchronized cardioversion (0.5-1 J/Kg)
 - Use of pharmacologic agent
 - Amiodarone 5mg/Kg IV over 20-60 mins
 - Procainamide 15mg/Kg IV over 30-60 mins
 - Identify and treat the underlying cause
- Adequate perfusion
 - Use of pharmacologic agent
 - Amiodarone 5mg/Kg IV over 20-60 mins
 - Procainamide 15mg/Kg IV over 30-60 mins
 - Synchronized cardioversion (0.5-1 J/Kg)
 - Identify and treat the underlying cause

Management of polymorphic VT

- Synchronized cardioversion (0.5-1 J/Kg)
- MgSO₄ 25-50 mg/ Kg, up to 2g
- Identify and treat the underlying cause (congenital condition, electrolyte imbalance, drug toxicity)



Pulseless Arrest

- VF
- Pulseless VT
- PEA
- Asystole

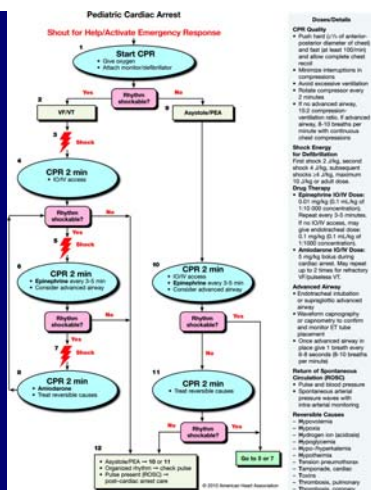
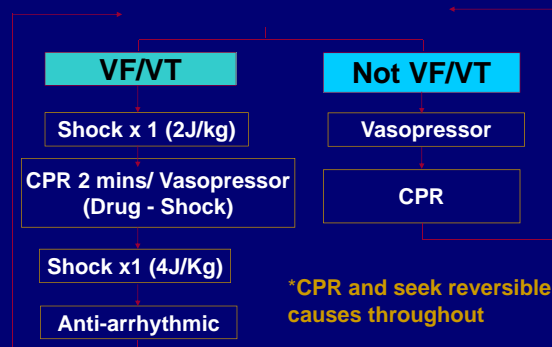
Case 5: Asystole?



VF



Pulseless Arrest*



Potentially reversible causes of life-threatening arrhythmia

- 6 H's
 - Hypoxemia
 - Hypovolemia
 - Hypothermia
 - Hypo-/Hyperkalemia
 - Hydrogen ion
 - Hypo-/Hyperglycemia
- 6 T's
 - Tamponade
 - Tension pneumothorax
 - Tablets
 - Thrombosis (AMI)
 - Thrombosis (PE)
 - Trauma

PEA 找原因

- 6H6T????
- 背不起來,怎麼辦? 誰來教我口訣?
- 兩心兩肺低氧高鉀酸藥威 → 口訣是考試用跟唬濫用的(可以在十秒內講出來...)

- 臨床: 問病史 看聽敲(兩心兩肺) 毒抽血 超音波
- 但小孩有多少有CAD?(小心 kawasaki..), 誰家小孩有pulmonary embolism? 沒有超音波誰敢戳 pericardial effusion, PEA怎麼聽distant heart sound? → 所以 只要考慮tension PTX!
- 創傷? 眼睛不會看啊! 會死的創傷→ internal bleeding, hemothorax, PTX→ 超音波!!
- Shaken baby syndrome? 先救活病人再說吧! 問病史!!

- 低血氧? 還要你說! ETT 早就on 好了
- 低血容? 還要你說! IV NS full run, 超音波→ 輸血?
- 酸,高低鉀, 低血糖 → 抽血!
- 毒物, 低體溫 → history
- 總結: PE(看聽敲) – tension PTX
 - 病史 – 毒 傷 溫
 - 抽血 – 鉀 糖 酸
 - 超音波 – 兩心兩肺 傷

Emergency Procedures

- Endotracheal intubation (RSI)
- Defibrillation and Cardioversion
- Intraosseous access

Endotracheal intubation

- RSI
- SOAP-ME
- Tracheal tube size = 4 + age/4
- Tracheal tube depth at lip = 3 x TT size

Basic RSI

- Airway assessment
- Preoxygenation
- Optional adjunctive agents (atropine, lidocaine)
- Sellick maneuver (cricoid pressure)
- Paralyzing agent
- Sedative agent
- Intubation and confirmation

Adjunctive Agents

- Atropine – anticholinergic
 - Probably useful in all children
 - Prevents bradycardia during intubation
 - Reduces oral secretions (e.g., ketamine)
- Lidocaine – lowers intracranial pressure
 - Given IV
 - Might be beneficial in head trauma cases or when ICP elevation is suspected

Sedative Agents

- No perfect sedative
- All sedatives may cause cardiovascular compromise.
- Selection is dependent upon clinical conditions.
- To simplify things, consider **etomidate** to be “default” sedative.

Thiopental

- Onset: 30 to 40 sec
- Duration: 10 to 30 min
- Benefits: Lowers ICP, lowers cerebral metabolism and oxygen demand, anticonvulsant
- Cautions: Myocardial depression. Giving this slowly reduces this adverse effect. Avoid in hypotension or patients in shock. May occasionally cause laryngospasm.

Midazolam

- Onset: 1 to 2 min
- Duration: 20 to 30 min
- Benefits: Reversible, amnestic, anticonvulsant, less likely to cause myocardial depression
- Cautions: Variable dose to achieve unconsciousness. Titration is required, which is not suitable for RSI. RSI requires a single dose.

Ketamine

- Onset: 1 min
- Duration: 30 min
- Benefits: Bronchodilator, sympathomimetic, less likely to cause myocardial depression.
- Cautions: Inject slowly to avoid vomiting; increases oral secretions (use atropine as an adjunctive agent), increases ICP, might cause emergence reactions

Etomidate

- Onset: Less than 1 min
- Duration: 10 to 20 min
- Benefits: Lowers ICP, supports blood pressure
- Cautions: Myoclonic excitation (might resemble seizures), immunosuppression

Sedative Selection

- Hypotension: Etomidate
- Status asthmaticus: Ketamine
- Head injury without hypotension: Thiopental or etomidate
- Unconscious in shock: Any agent may adversely affect circulation. Consider using no sedative or a low dose in conjunction with shock resuscitation.

Paralyzing Agents

- Also called muscle relaxants
- Succinylcholine
 - Onset 30-60 sec, duration 3-8 min
 - Shorter duration, higher risk of adverse effects
- Rocuronium
 - Onset 1-3 min, duration 30-45 min
 - Longer duration, but less potential for adverse effects

Succinylcholine

- “Depolarizing” muscle relaxant
 - Depolarizes muscle first (causing “fasciculations”), then paralysis
 - Fasciculations may cause muscle pain and myoglobinuria, more common in muscular adults
- Higher risk of hyperkalemia, especially following burns and/or crush injuries
- Higher risk of malignant hyperthermia
- Fastest onset time, short duration (3-8 min) in case intubation is not achieved

Rocuronium

- “Nondepolarizing” muscle relaxant, no fasciculations.
- Other drugs in group: vecuronium, pancuronium, atracurium, mivacurium. Rocuronium has the fastest onset time and fewest adverse effects.
- Onset time is slower than succinylcholine, but in practice, intubation initiated at 60-90 sec after administration, slightly slower than succinylcholine.
- Longer duration (30-45 min) in case intubation is not achieved. Partially reversible with edrophonium.

Paralyzing Agent Selection

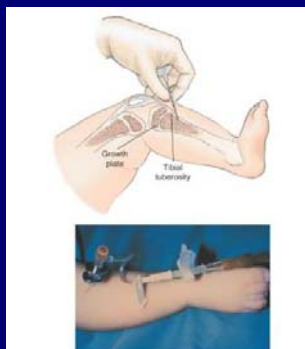
- Physician preference
- Onset time: Succinylcholine faster
- Duration: Succinylcholine shorter
- Adverse effects: Fewer with rocuronium
- Intubation conditions: Approximately the same

Defibrillation and Cardioversion

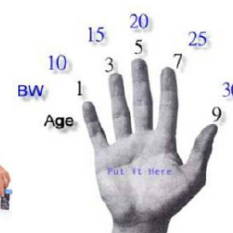
- Paddle size:
 - 4.5 cm for infants (< 1 yr, or < 10 kg)
 - 8 or 13 cm for older children (> 1 yr, or > 10 kg)
 - Rule of thumb: Largest paddle size possible



Intraosseous access



Broselow Tape®



- Ch 113 fever and serious bacterious illness
- Ch119 stridor and drooling
- Ch120 wheezing
- Ch 121 pneumonia
- Ch124 acute abdomen in children