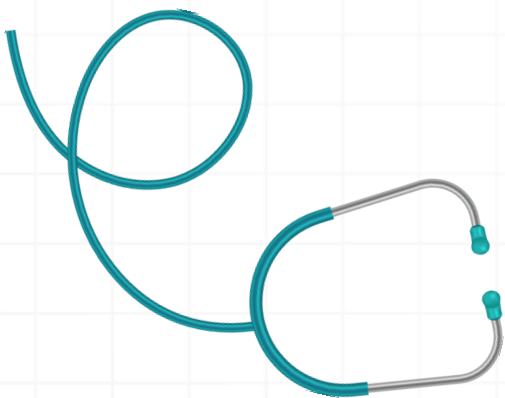


ภาวะวิกฤตระบบหัวใจในเด็ก

Cardiac Emergencies in Children

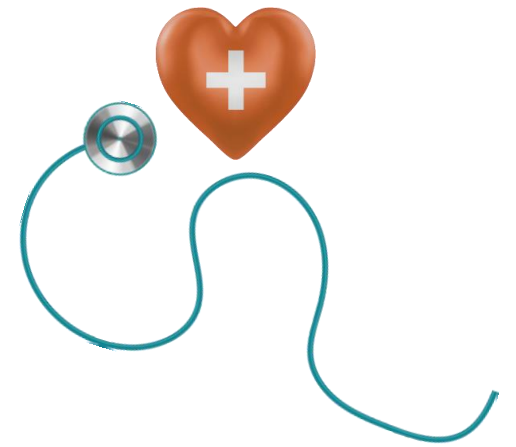


SPEAKER

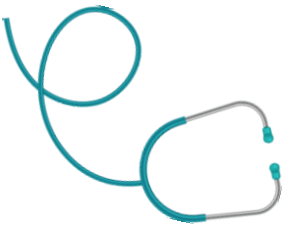
Assist.Prof. Yuttapong Wongswadiwat
Division of Pediatric Cardiology
Srinagarind Hospital, Khon Kaen University



Outline



- Cardiogenic shock
- Ductal-dependent cardiac lesions
- Hypoxic spell
- Cardiac tamponade
- Cardiac emergencies in PALS



Cardiogenic shock

Hypovolemic shock

Cardiogenic Shock

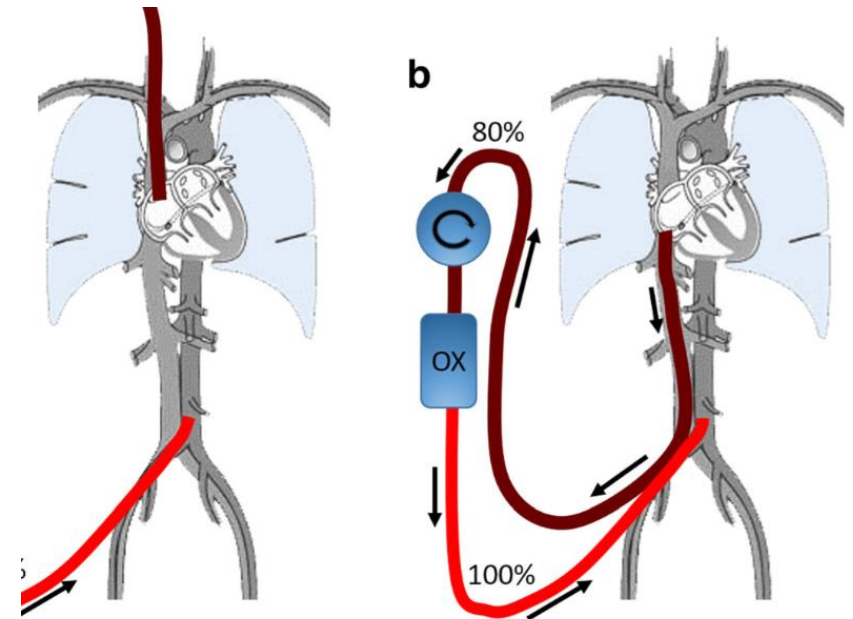
Cardiomyopathies, Arrhythmias

Distributive Shock

Sepsis, Anaphylaxis, Neurogenic

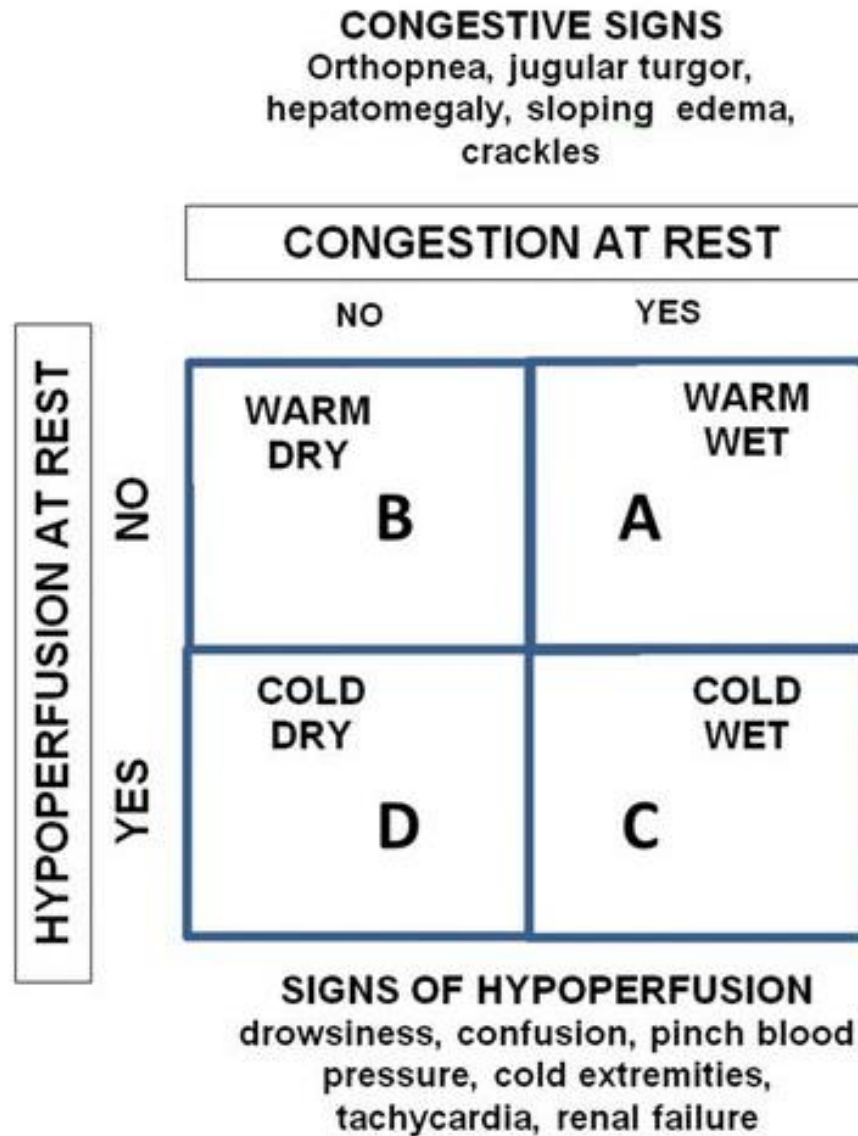
Obstructive Shock

*Cardiac tamponade, tension pneumothorax
massive pulmonary embolism,
ductal-dependent CHD: CoA, IAA*



Freneckner et al. Critical care(2018) 22:163

Cardiogenic shock – Warner Stevenson concept



Pathophysiological states in cardiogenic shock

Cold and wet (systolic & diastolic dysfunction)

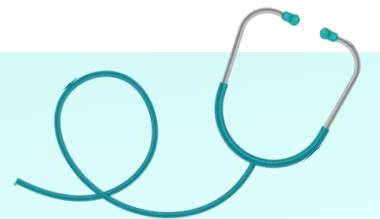
↓ Myocardial contractility
↑ LV filling pressure

Cold and dry (systolic dysfunction)

↓ Myocardial contractility
↓ LV filling pressure

Warm and wet (diastolic dysfunction)

↔ Myocardial contractility
↑ LV filling pressure



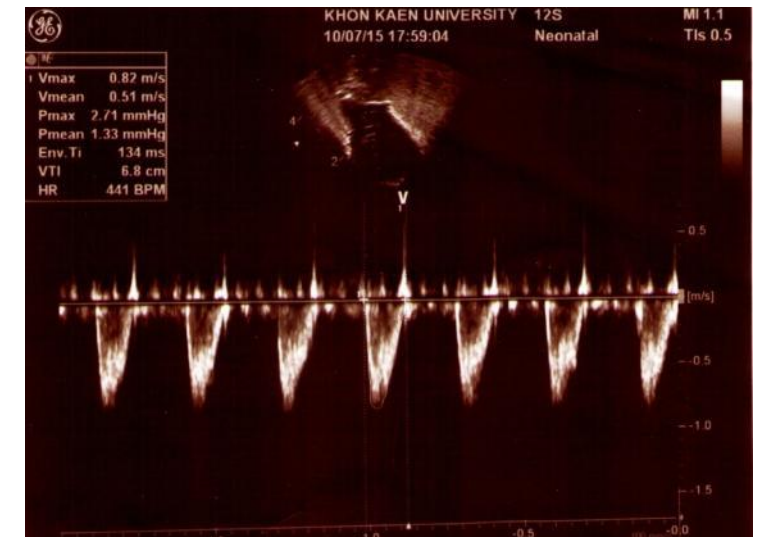
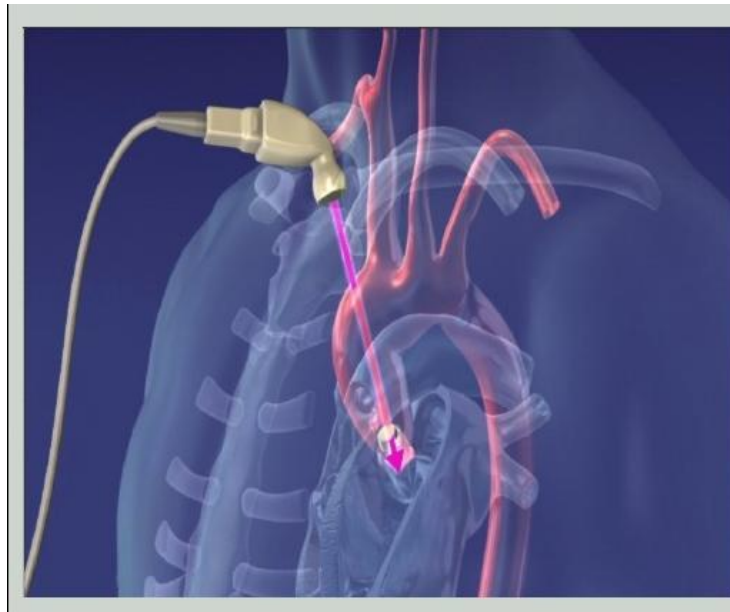
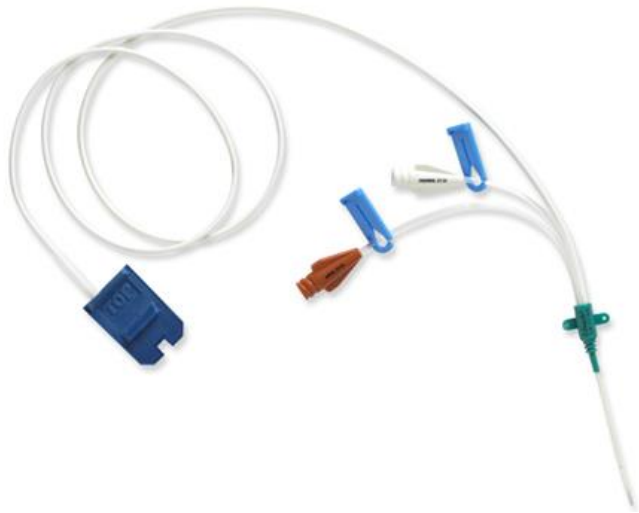
Cardiovascular Monitoring

Invasive monitoring : CVP, arterial line

Non-invasive monitoring

CO monitoring, ScvO₂ monitoring, USCOM

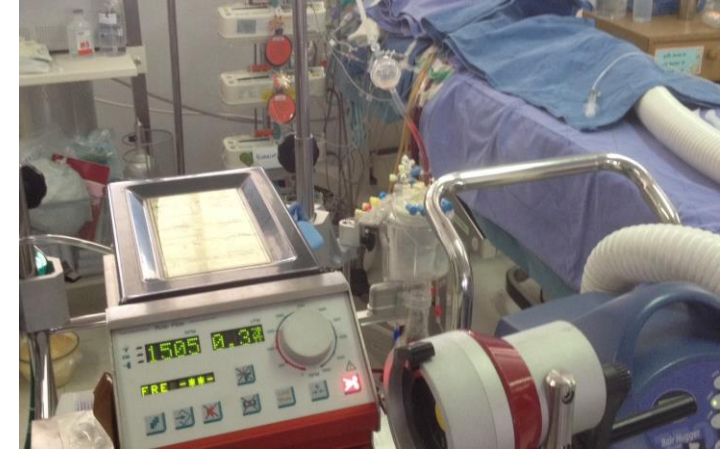
ECHO : EF, FS, SVC flow, SVC diameter, CO



Management of cardiogenic shock in children

(Experts' recommendations for the management of cardiogenic shock in children)

- Suggestive clinical & para-clinical signs
- Ventilation optimization(reduce afterload)
- Preload and afterload optimization
- Treatment of curable disease & arrhythmia
- Medication therapy :
 - 1st line Dobutamine
(milrinone is alternative)
 - 2nd line Noradrenaline (levosimendan)
 - 3rd Vasopressin/ECMO



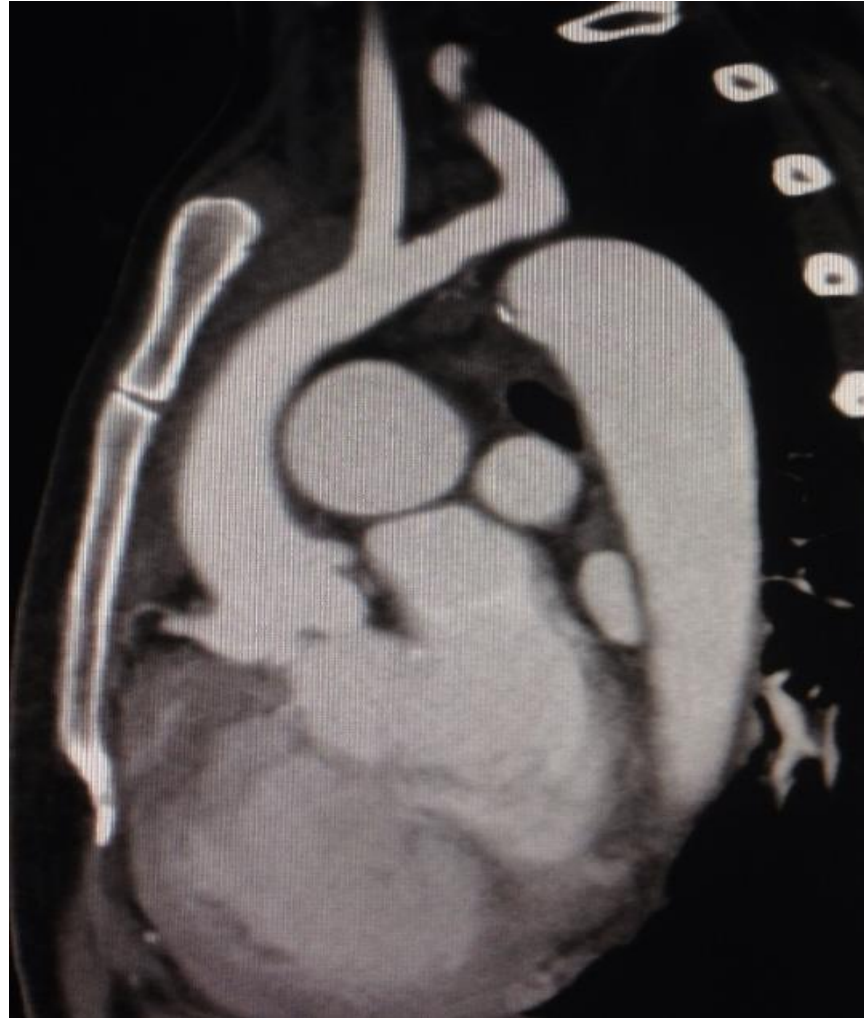
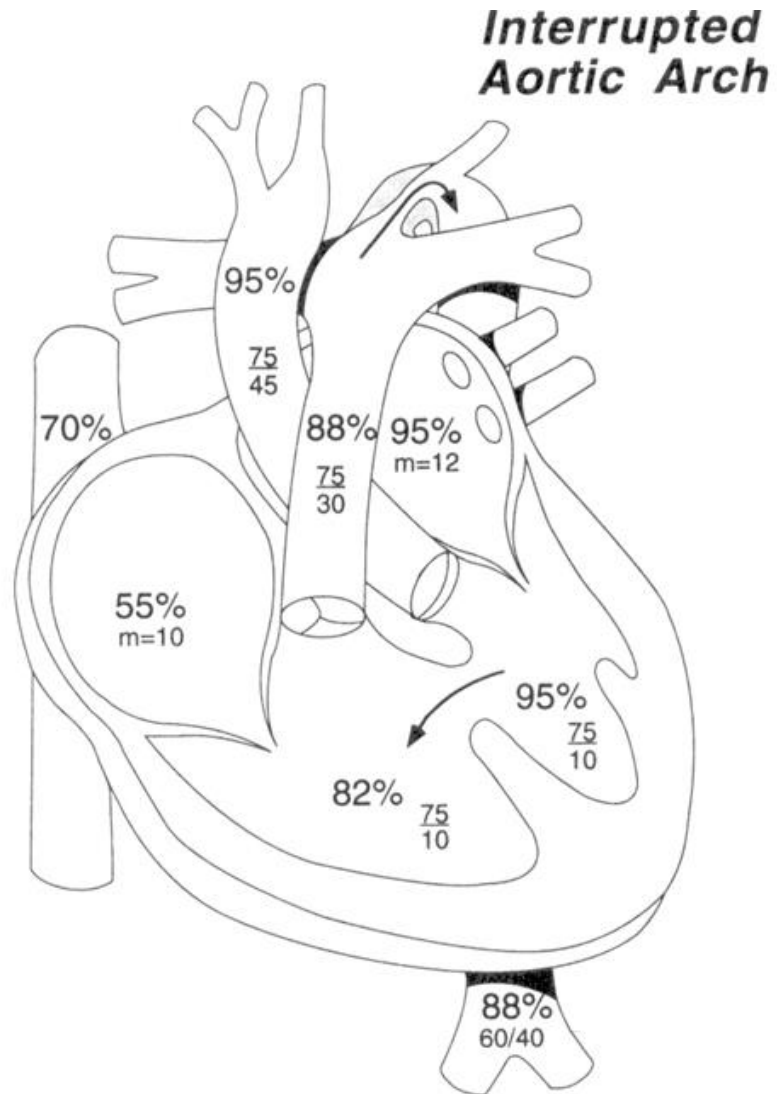
Ductal dependent cardiac lesions

- **Critical congenital heart diseases (CCHD)**
- CHD requiring surgery or catheter intervention in first year of life
- About 25% of CHD

Pathophysiology

- Ductal dependent for systemic blood flow: IAA
- Ductal dependent for pulmonary blood flow: PA
- Ductal dependent mixing: TGA

Interruption of the aortic arch



Early life-threatening presentation

Shock : poor perfusion

Cyanosis : hypoxia

Differential cyanosis :

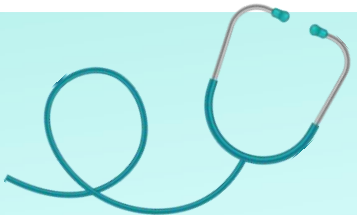
PPHN, severe CoA with PDA

Reverse differential cyanosis:

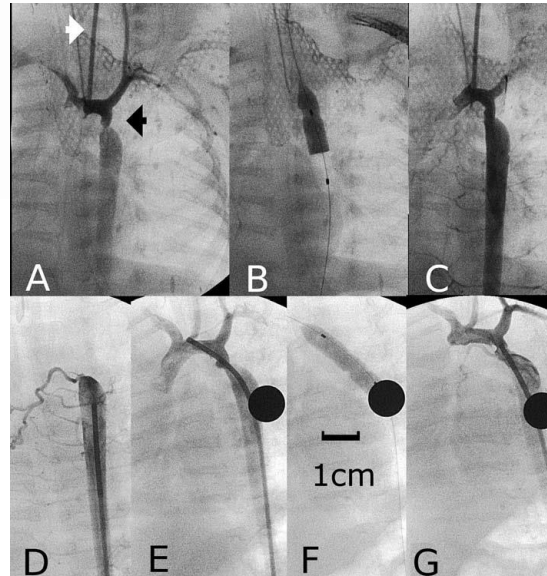
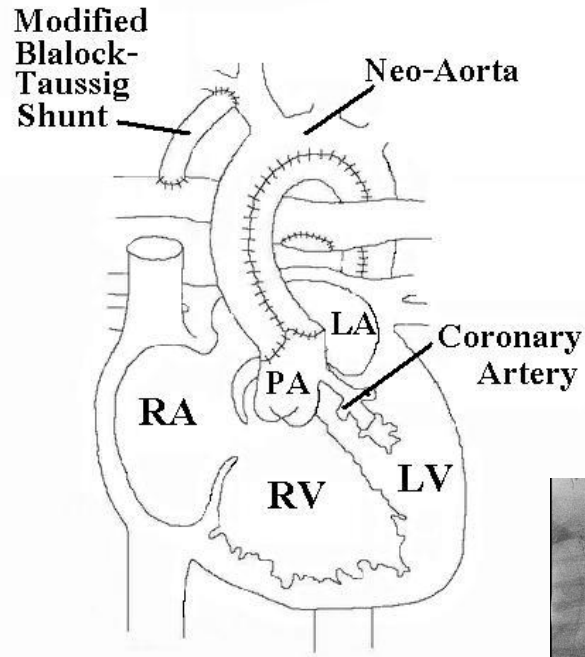
dTGA with CoA/PPHN

Pulmonary edema ; restricted PFO

Respiratory symptoms



Management of CCHD

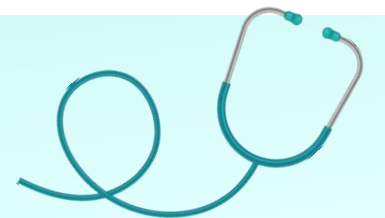


- Stabilization
- Oxygen saturation 75-80%
- Prostaglandin(PGE1)
- Catheter intervention : Balloon angioplasty/valvulotomy
- Surgery : Coarctectomy, Norwood BTT shunt

Prostaglandin E1



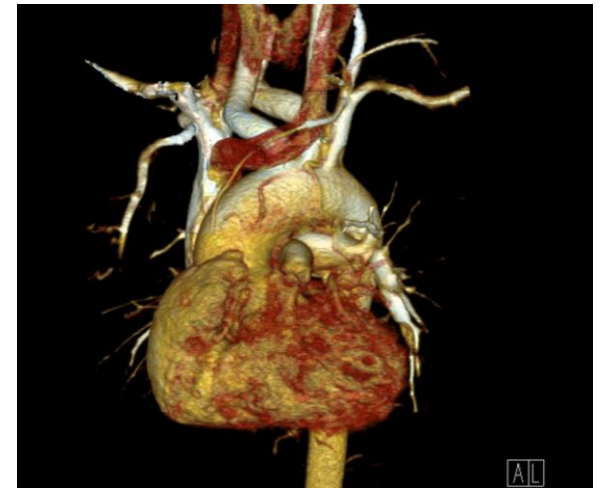
- Open ductus arteriosus
- Keep at 2 – 8 C
- Dose 0.05 – 0.4 mcg/kg/min
- Diluent: D5W, NSS
- Stability 24 hours after dilution
- Final conc. 2 – 20 mg/ml
- Fever, apnea, seizure, low plt hypotension, DIC



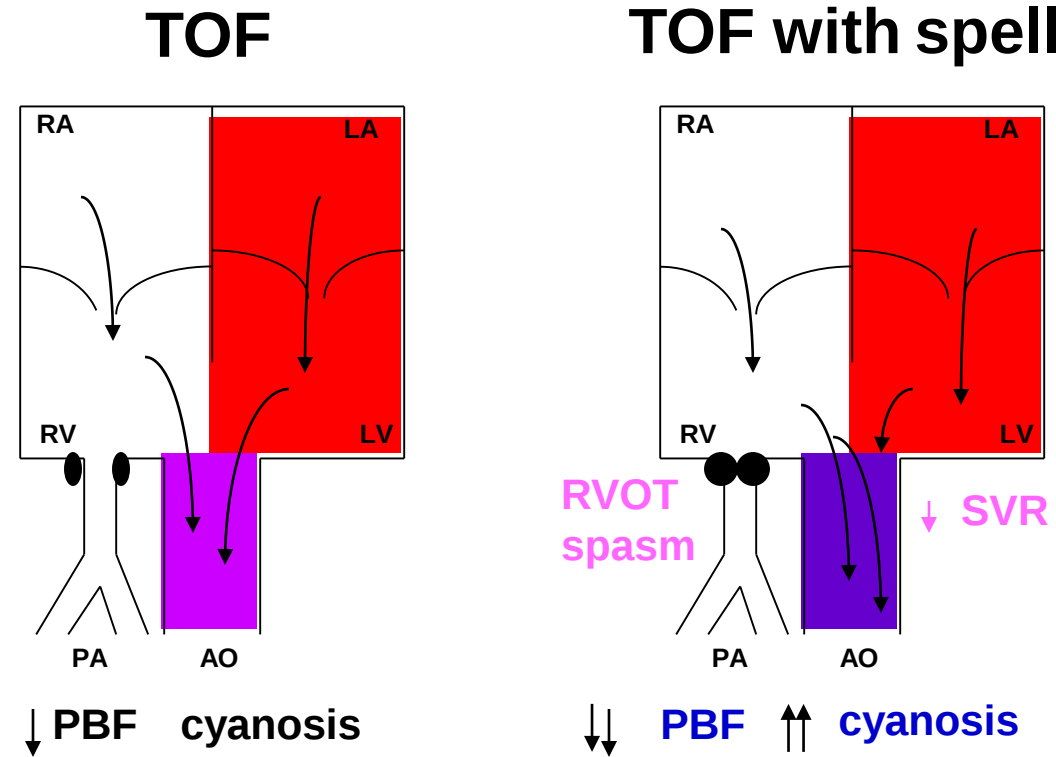
Hypoxic spell



- Cyanotic CHD
- Tetralogy of Fallot →
- Decrease pulmonary blood flow and right to left shunt
- Squatting
- Increasing cyanosis
- Unconscious
- Death
- Emergency management



Hemodynamics of TOF spells

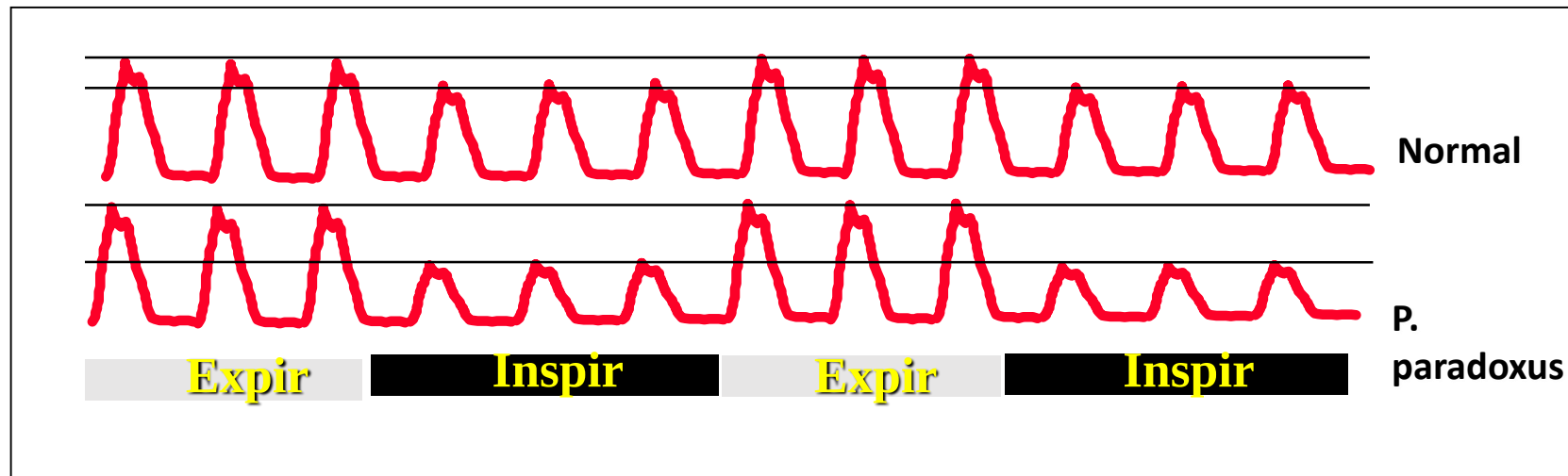
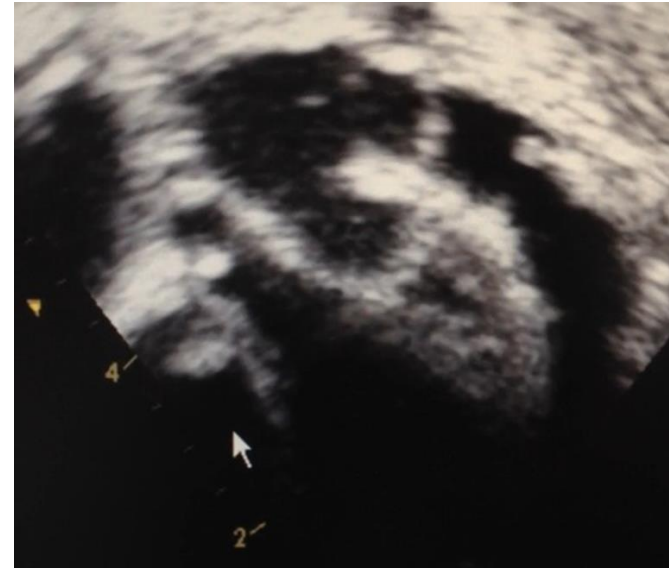


Treatment of hypoxic spell

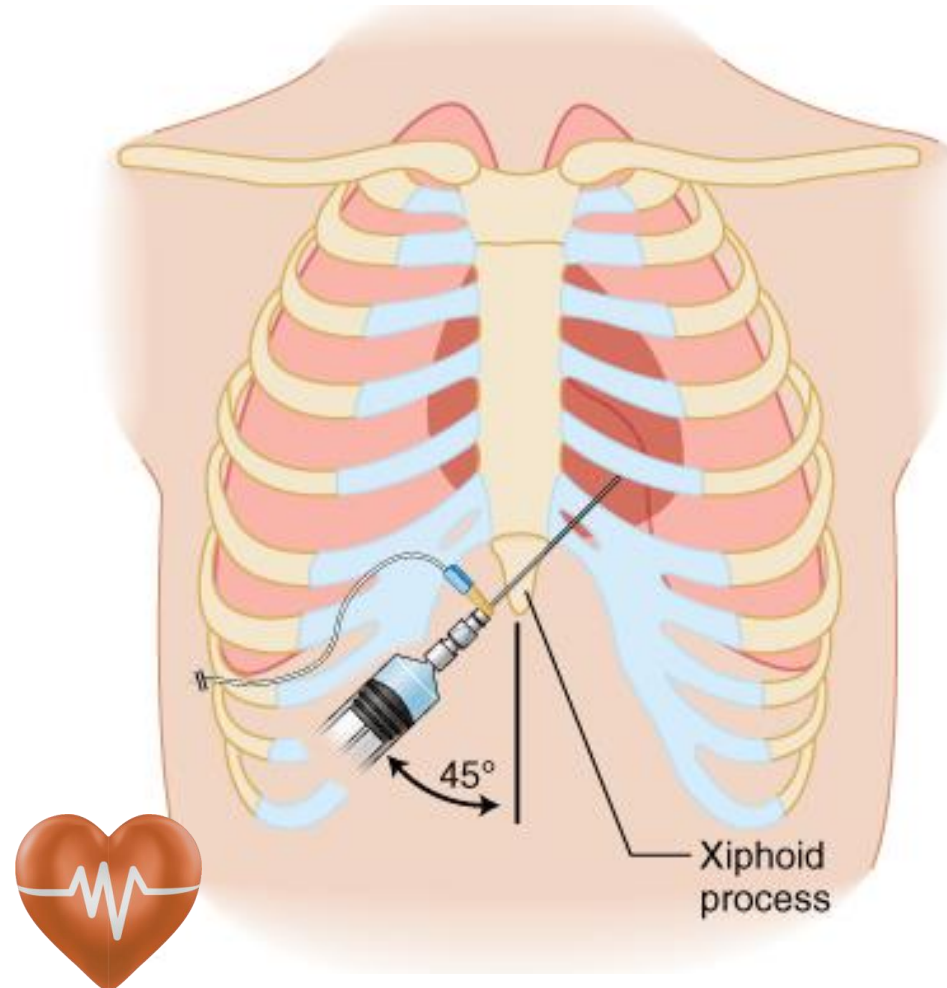
- Knee to chest position
- Oxygen
- Morphine IM/IV
- Volume replacement 10-20 ml/kg
- Correct acidosis/hypoglycemia
- Esmolol/Propranolol
- Vasoconstrictors
- General anaesthesia and ventilation
- Systemic to pulmonary shunt
 - * Ongoing care: oral Propranolol

Cardiac tamponade ❤️+

How to detect tamponade ?
PE & Investigation
Management



Pericardiocentesis



<http://www.fprmed.com/Medical/procedures/Pericardiocentesis3.png>

Cardiac emergencies in PALS

Pediatric BLS

Pulse + inadequate respiratory effort(update)
1 breath every 2-3 sec (20-30 breaths/min)

One rescuer

30 compression

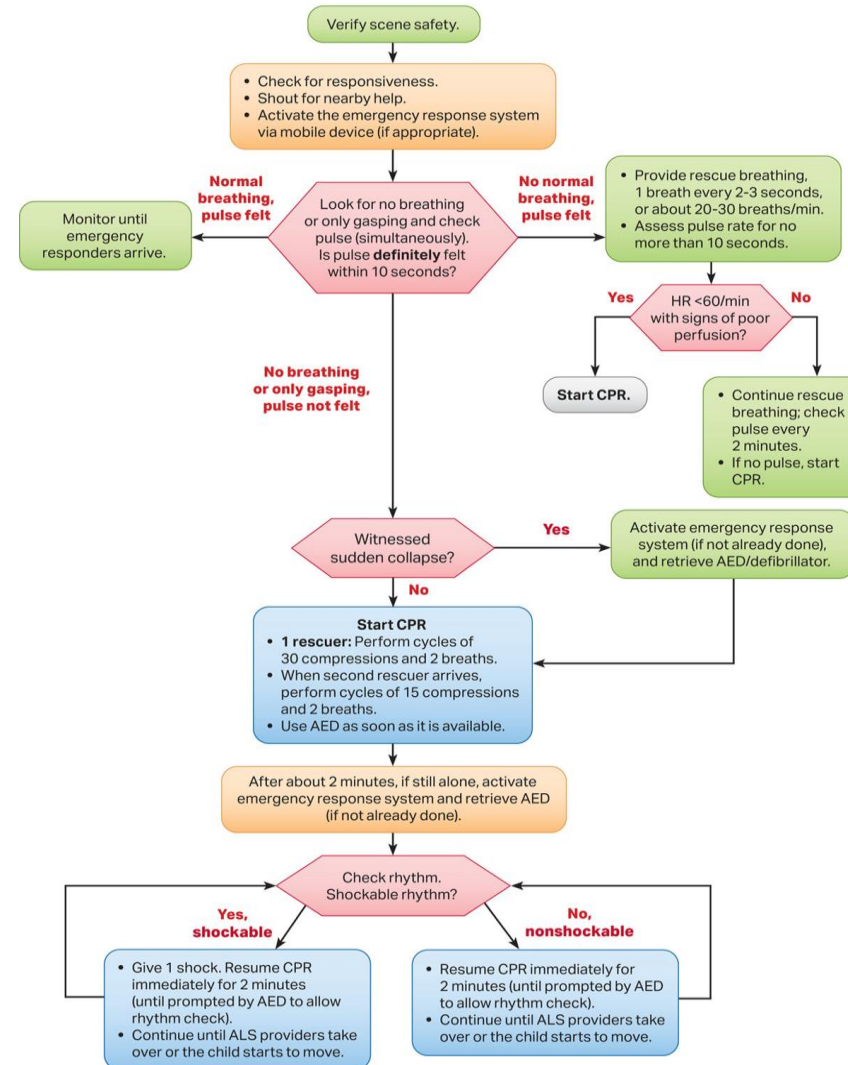
: 2 breaths

Two rescuers

15 compression

: 2 breaths

Pediatric Basic Life Support Algorithm for Healthcare Providers—Single Rescuer



Pediatric cardiac arrest

Initiation of CPR : lay rescuers & HCP

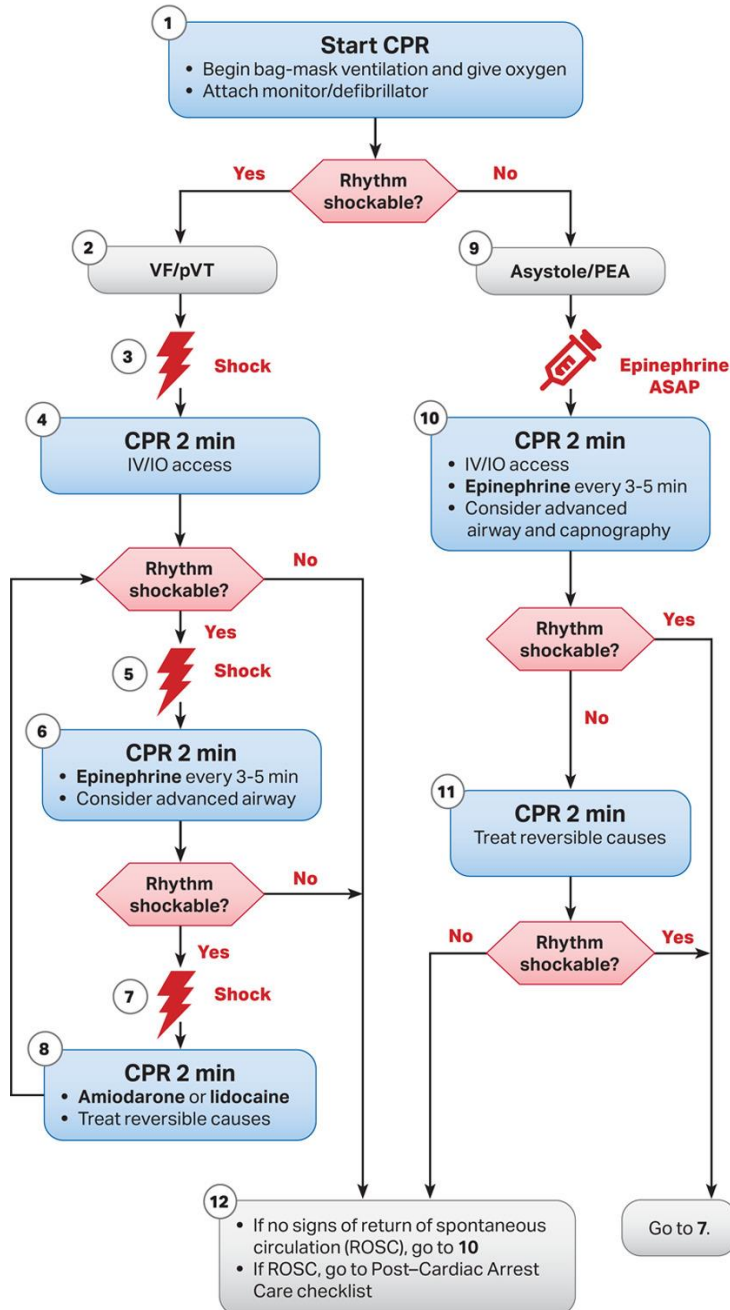
Compression – Airway – Breathing

High quality CPR

- Adequate chest compression **depth**
- **Rate** 100-120/min
- Minimizing **interruption** ** coronary perfusion
- Allowing full **chest recoil** after each compression
- Avoid **excessive ventilation**
- Pulse check q 2 min, no more than 10 secs



Pediatric Cardiac Arrest Algorithm



CPR Quality
- Push hard ($\geq \frac{1}{3}$ of anteroposterior diameter of chest) and fast (100-120/min) and allow complete chest recoil - Minimize interruptions in compressions - Change compressor every 2 minutes, or sooner if fatigued - If no advanced airway, 15:2 compression-ventilation ratio - If advanced airway, provide continuous compressions and give a breath every 2-3 seconds
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 IV/IO dose: 0.01 mg/kg (0.1 mL/kg of the 0.1 mg/mL concentration). Max dose 1 mg. Repeat every 3-5 minutes. If no IV/IO access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of the 1 mg/mL concentration). Amiodarone IV/IO dose: 5 mg/kg bolus during cardiac arrest. May repeat up to 3 total doses for refractory VF/pulseless VT - or Lidocaine IV/IO dose: Initial: 1 mg/kg loading dose
Advanced Airway
- Endotracheal intubation or supraglottic advanced airway - Waveform capnography or capnometry to confirm and monitor ET tube placement
Reversible Causes
- Hypovolemia - Hypoxia - Hydrogen ion (acidosis) - Hypoglycemia - Hypo-/hyperkalemia - Hypothermia - Tension pneumothorax - Tamponade, cardiac - Toxins - Thrombosis, pulmonary - Thrombosis, coronary

Update

***Epinephrine ASAP < 5 min**

***Use ABP if A-line in place**

DBP & CPR quality

DBP infant ≥ 25 mmHg

Children ≥ 30 mmHg

***Advanced airway**

Cuffed ETT is preferred

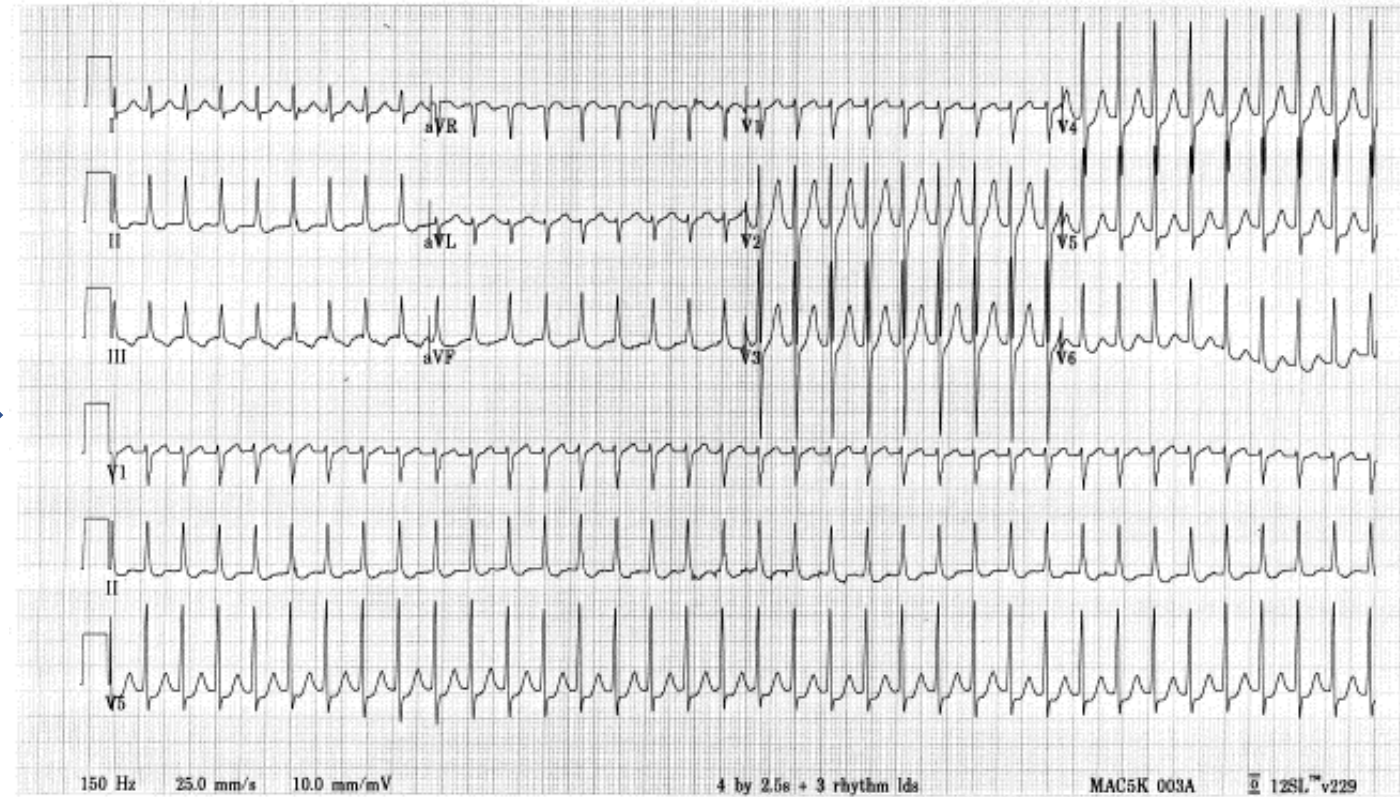
ETCO2 confirm ETT placement

& during transport

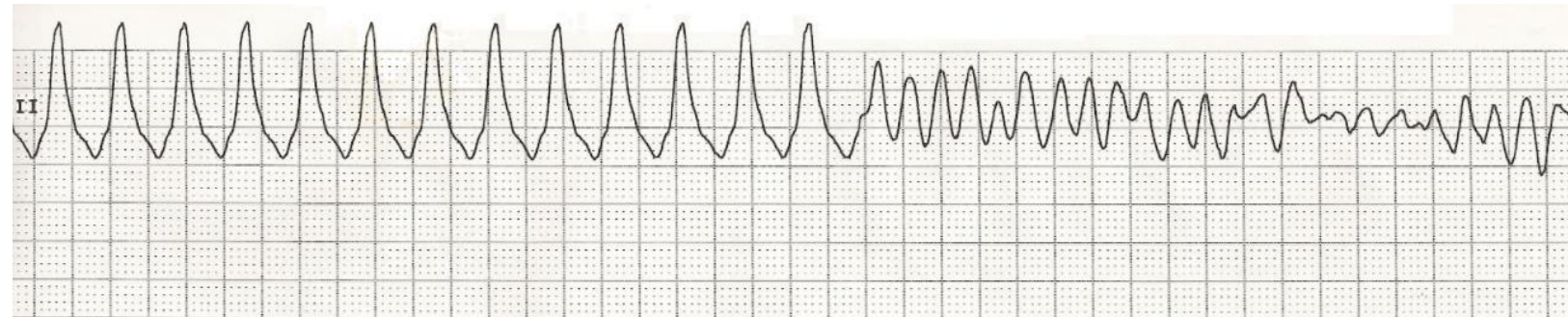
No routine cricoid pressure

***Amiodarone or lidocaine**

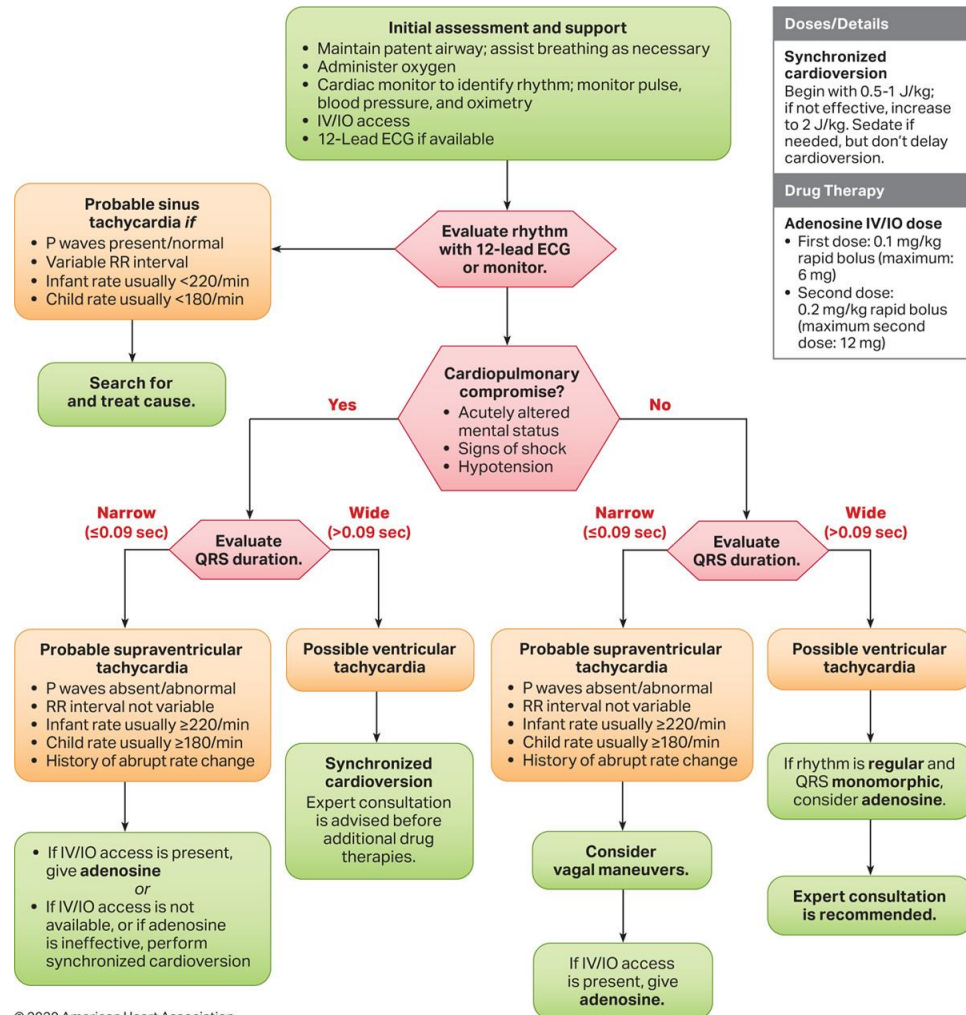
Supraventricular tachycardia



Ventricular tachycardia

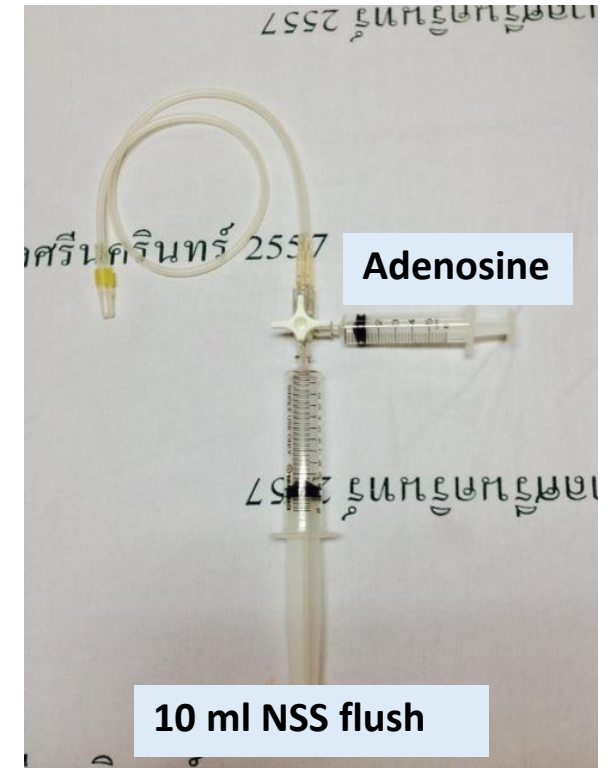


Pediatric Tachycardia With a Pulse Algorithm



© 2020 American Heart Association

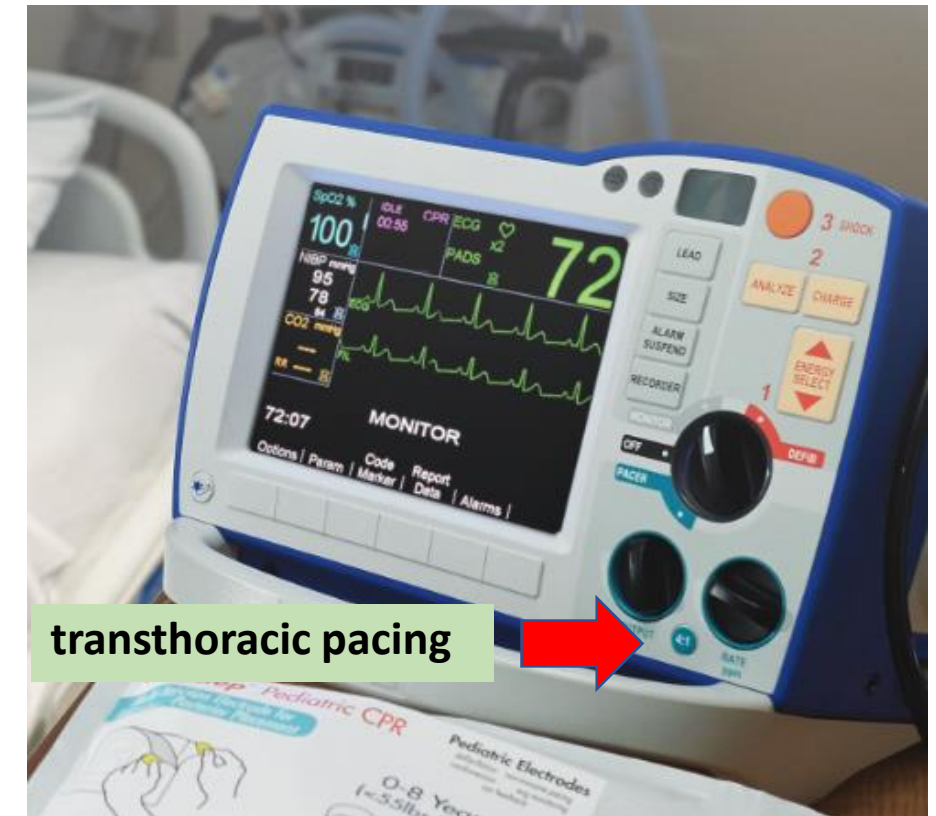
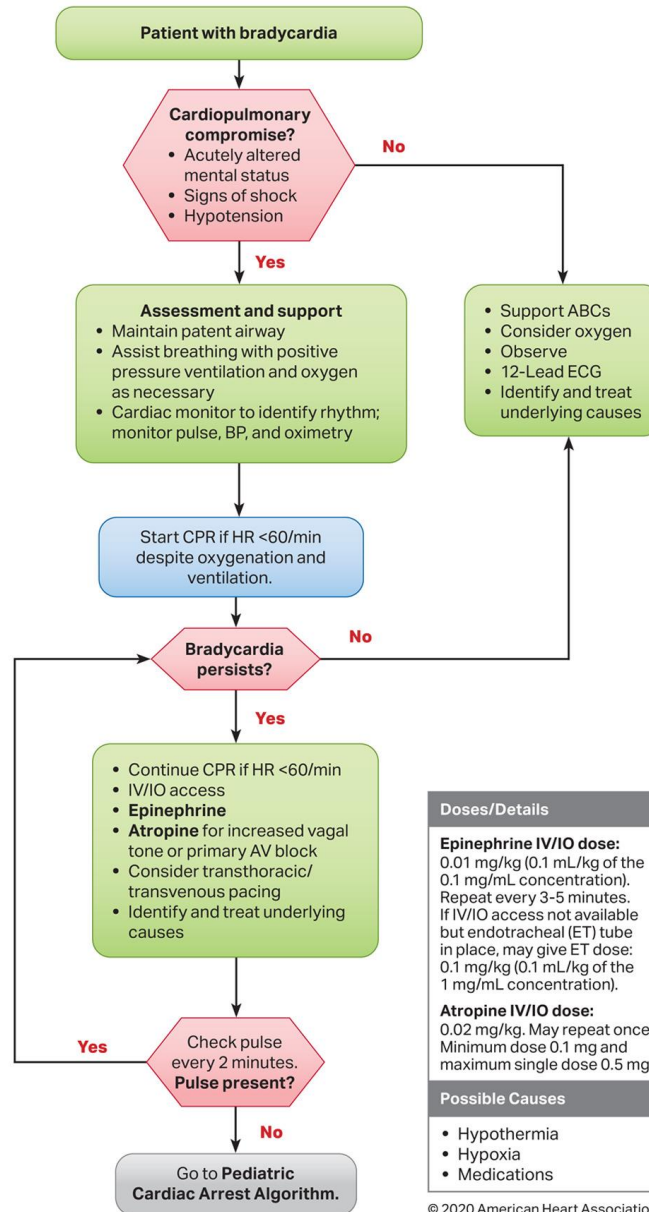
- **Cardiopulmonary compromise?**
- **QRS duration: Wide/narrow complex**
- **Synchronized cardioversion**
- *** pre-charge**



Pediatric Bradycardia With a Pulse Algorithm

Assisted ventilation
1 breath q 2-3 sec
(20-30 bpm)

Atropine
Increased Vagal tone:
NG/ETT placement
Primary AV block



Transthoracic/transvenous pacing

- *Complete heart block
- *Sinus node dysfunction
- *Unresponsive to ventilation/oxygenation /Chest compression/medication esp. congenital/acquired heart disease

PALS 2020 UPDATES

- **Assisted ventilation rate** (with or without advanced airway)
1 breath q 2-3 sec = 20-30 /min
- **Intubation**
 - Cuffed ETT is preferred
 - No routine cricoid pressure
- **CPR**
 - Epinephrine as soon as possible(ASAP) ≤ 5 min
 - Use ABP if A-line in place
- **After ROSC**
 - Post-cardiac arrest checklist : who do not regain consciousness
- **Opioid overdose**
 - Naloxone : no benefits in patients with cardiac arrest (no evidence)
- **Septic shock**
 - Titrated fluid 10-20 ml/kg and reassessment
 - Vasopressor: Epi/NE in fluid refractory septic shock





Thank you Q&A

