Approach to cardiac emergencies in pediatrics

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Case 1

Adam, 5-hour-old male newborn on the postnatal ward is noticed by the midwife because he looks blue around the lips and tongue.

He is the first child of a 27-year-old mother who has no known medical conditions. Antenatal scans were unremarkable. She went into spontaneous labour at 41 weeks, when the membranes ruptured 1 hour before delivery. Cardiotocograph (CTG) monitoring during labor revealed normal variability of fetal heart rate. The baby was born by normal vaginal delivery and weighed 3.3 kg. The Apgar scores were 7 at 1 min and 8 at 5 min. It's vital to mention that there's no family history of congenital heart diseases.

Physical examination:

- Upon examination, Adam appeared cyanotic even after being given supplemental oxygen. He was tachypneic as his respiratory rate was 70 breaths per minute. His heart rate was 150 bpm. His Blood pressure was within the normal range for his age. He had cool extremities and a weak femoral pulse.
- Upon auscultation, heart sounds were normal, but there was a prominent single loud second heart sound (S2). There was no murmur detected. The liver was not enlarged, and there were no other abnormal findings upon examination.
- Growth parameters: HC: 34 cm Length: 50 cm Weight: 3kgs
- Vitals : RR: 70 HR:150 bpm T: 36.6 degree C O2 sat: 70% pre and post ductal

Differential diagnosis:

It could be of cardiac, respiratory, metabolic or of a CNS cause:

- Cardiac: TGA,TOF,TAPVR,TA,Truncus arteriosus, ebsteins anomaly and so on.
- Respiratory: TTN, pneumonia, a pulmonary anamoly, pulmonary hemorrhage.
- CNS: seizures, toxins, IVH, ischemia
- Infections: pneumonia, meningitis, sepsis.
- Others: inborn erros of metabolism, hypoglycemia

Investigations:

1- CXR : Egg on a string" appearance of the heart.

The enlarged, globular heart resembles an egg lying on its side.

The string represents the superior mediastinum that appears narrow due to stress-induced thymic atrophy.

↑ Pulmonary vascular markings.

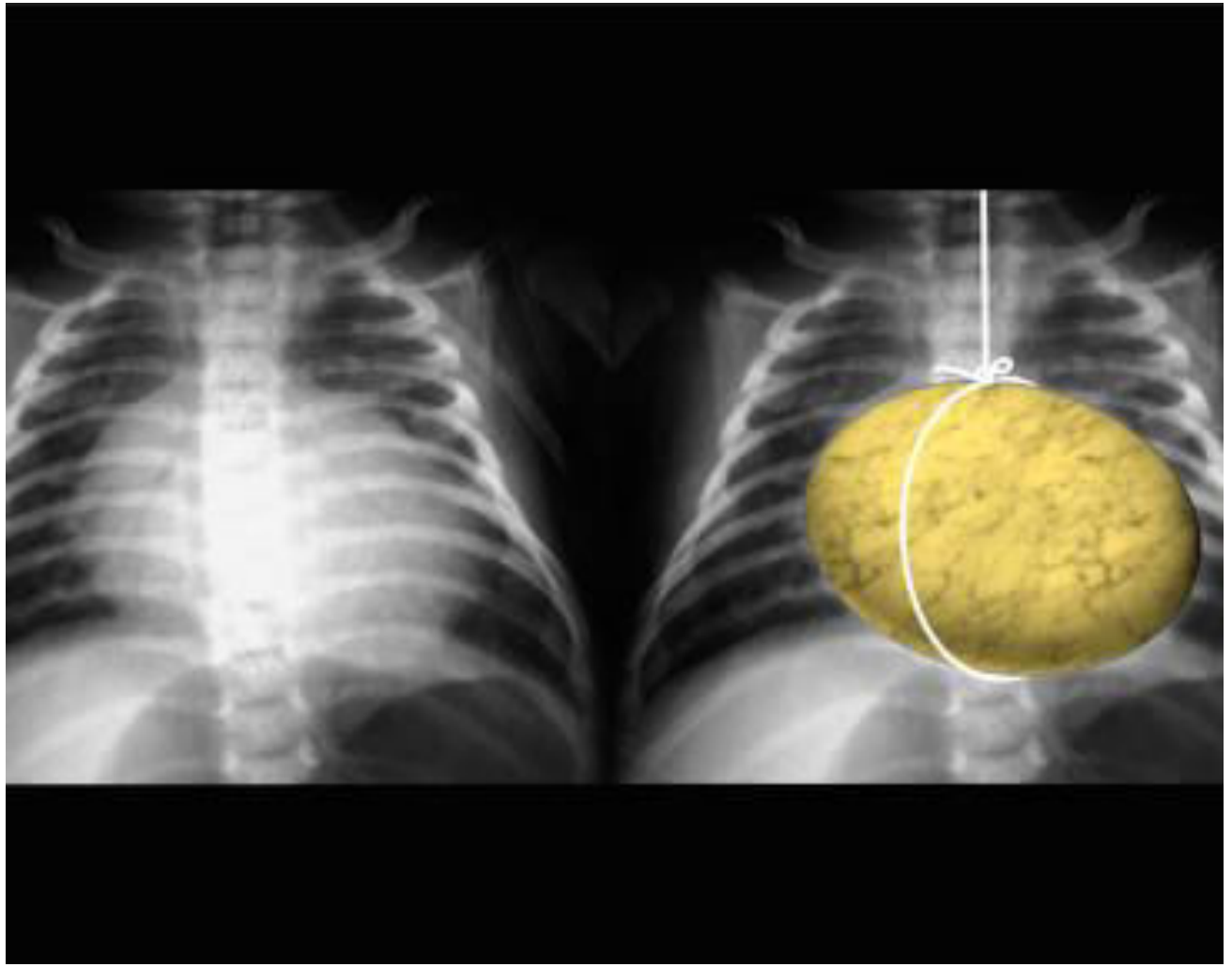
2-ECG : often normal, but may show right ventricular hypertrophy and right axis deviation.

3- Echo (the diagnostic test): the pulmonary artery arising from the left ventricle and the aorta from the right ventricle .

4- pulse oximetry : a decrease in the spO2.

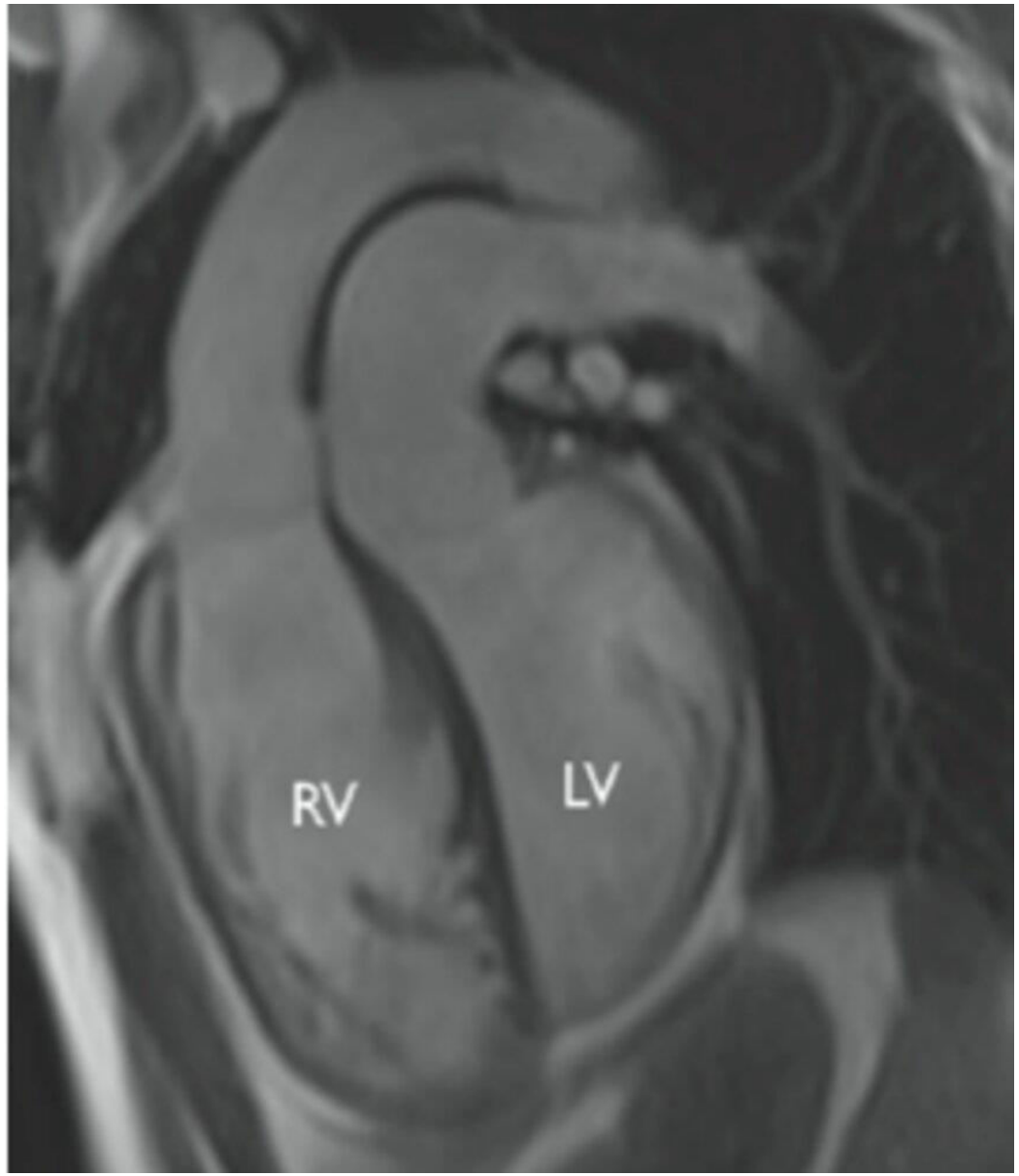
5- Hyperoxia test

The typical “ egg on a string” sign seen in patient with TGA



Management :

- We must correct the metabolic acidosis
- Give O2 and treat sypmtoms of heart failure (if it had occurred) .
- Infusion of PGE1 to prevent the early closure of the pda.
- Ballon atrial septostomy (Rashkind procedure) to create on enlarge an existing ASD.
- Ultimately, these patients, need surgical repairing, by the so called procedure “Arterial switch procedure” which should be done in the first two weeks of life.


RV
LV

Case 2

A 6-day-old male newborn was brought to the pediatric emergency department by his parents due to concerns about his breathing and poor feeding. According to the parents, the baby was born at full term without any complications during pregnancy or delivery. However, shortly after birth, they noticed that the baby had difficulty breathing, especially while feeding, and he seemed to be in distress. they observed bluish discoloration and coolness of the feet. There were no known pre-existing medical conditions or congenital abnormalities in the family history

Physical exam

General Appearance :

-Baby appeared pale and cyanotic (bluish diacoloration) of the lower limb

-He exhibited signs of respiratory distress, including nasal flaring and intercostal and subcostal retractions.

Vital signs :

HR: 160 bpm

RR: 70 bpm

BP:

Upper extremities 80/55 mmHg

Lower extremities: 60/40 mmHg

T: 37 C

O2 Sat : right arm 93

Lower limb 80

Cardiovascular examination :

- Grade 2 systolic murmur was heard over the left sternal border.
- Femoral pulses were weak and delayed compared to radial pulses
- Capillary refill time prolonged (greater than 3 seconds) in the lower extremities

Respiratory Examination:

Crepitation

abdominal examination :

Soft,non tender , liver was palpable on examination

Differential diagnosis

Left side obstructive lesions such as:

- Coarctation of the aorta
- Critical Aortic stenosis
- Hypoplastic left heart syndrome
- Interrupted aortic arch

*fulminant sepsis

Investigations

- CBC : normal
- ABGS: metabolic acidosis
- KFT : impaired
- Chest x ray : cardiomegaly and pulmonary edema
- increased pulmonary vascular markings
- ECG: right ventricular hypertrophy
- Echo : diagnostic test

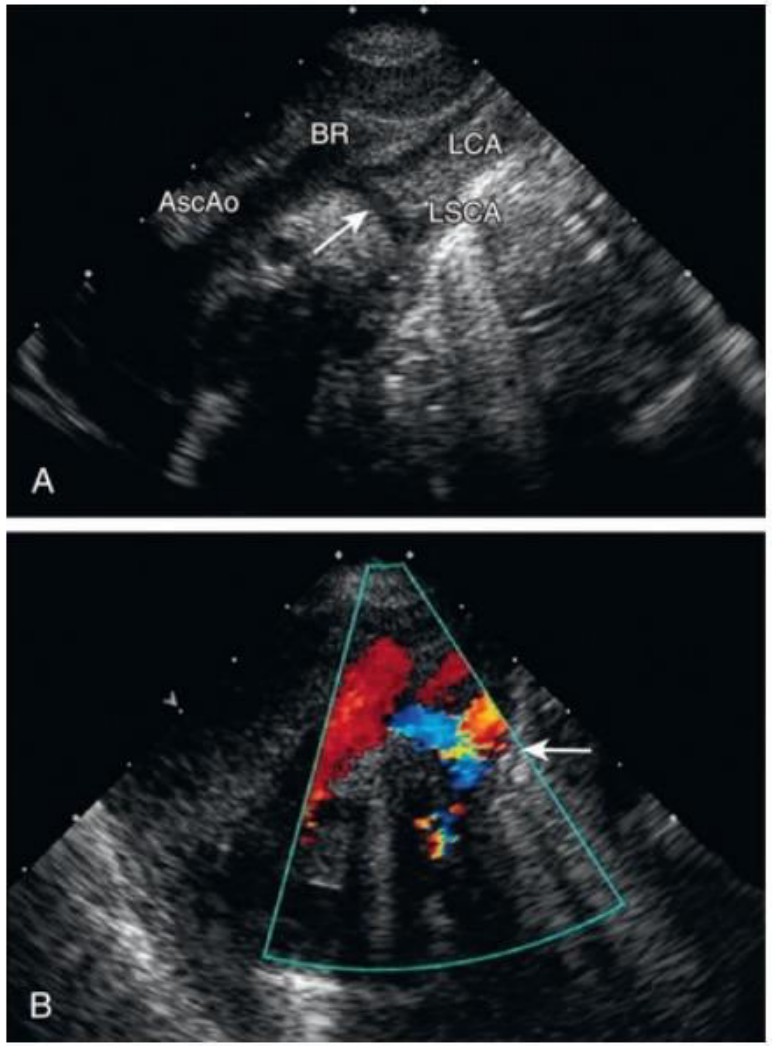
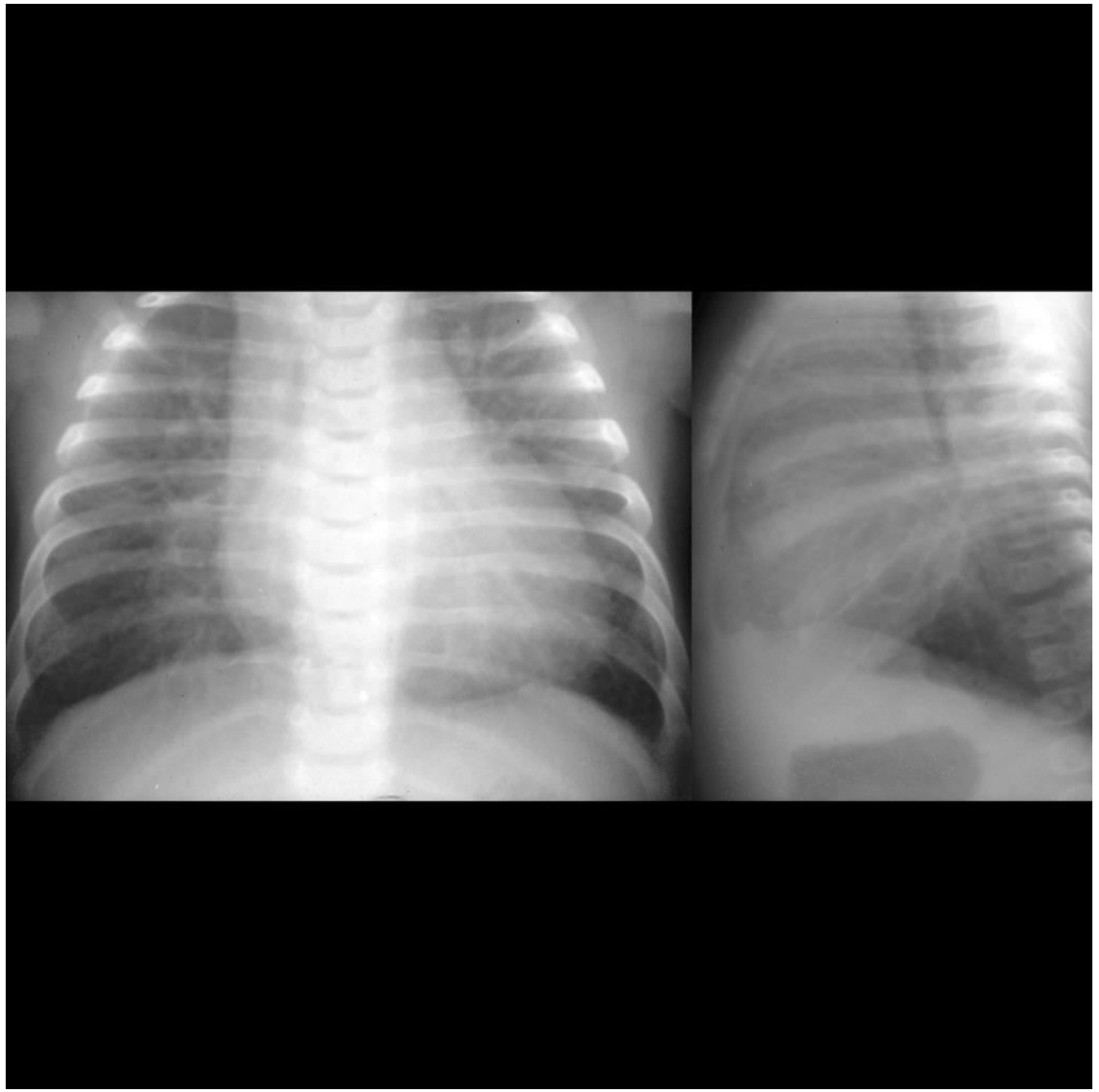
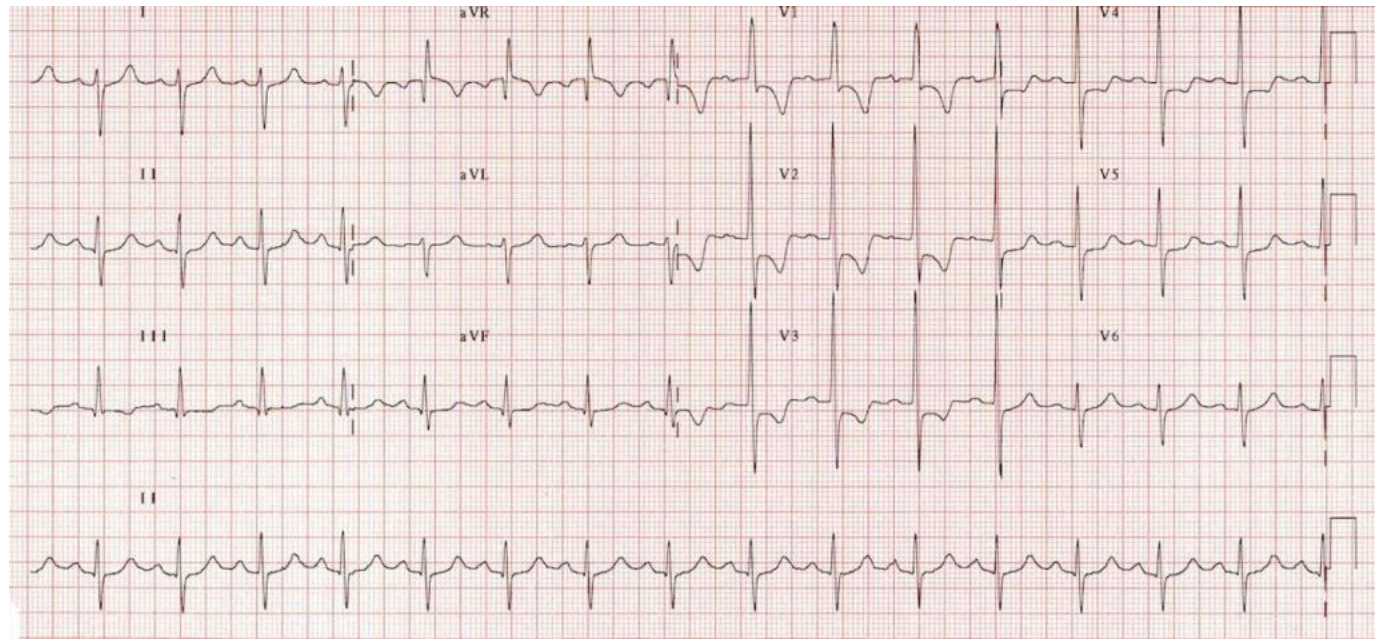


FIG. 454.8 Echocardiogram demonstrating coarctation of the aorta with hypoplastic transverse arch. A, Suprasternal notch 2D echocardiogram showing marked narrowing beginning just distal to the brachiocephalic artery. B, Color Doppler demonstrates turbulent flow in the juxtaductal area *(arrow)*. AscAo, Ascending aorta; BR, brachiocephalic artery; LCA, left carotid artery; LSCA, left subclavian artery.




I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

Neonatal coarctation of the aorta

- Coarctation of aorta infantile type is a preductal lesion – narrowing occurs proximal to ductus arteriosum.
- Heart failure is due to sudden increase in afterload.

Management

- prostaglandin E1
- Ionotropic drugs (dopamine , dobutamine , epinephrine)
- Diuretics
- Monitor renal function and urine output
- Monitor ABGs and metabolic acidosis
- After stabilization pt will be ready for surgical intervention

Case 3

Ahmad 9-year-old male who lives in Amman his parents brought him to the emergency department on 7th of July at 9:00 pm with a chief complaint of **palpitations for 3 hours.** The history was taken from his mother

History of presenting illness

This episode of palpitation started **suddenly** at rest and continued for 3 hours he felt his heart pounding in his chest, also he became restless and had chest discomfort, with dyspnea, and sweating, also it is not the first episode.

He had similar episodes of palpitation that have been happening for the past few weeks. The episodes last a few minutes to an hour and have occurred at least once a day. These episodes started suddenly and sometimes occur during physical activity or excitement, but they have also noticed them happening at rest.

No chest pain, no loss of consciousness, no cough, no wheezing, or fever during this episode or in the previous episodes. Outside of these episodes, he appears healthy, There is no past medical history of note and he is on no medication, no family history of the same complaints or cardiac diseases.

Physical Examinations

The patient was pall, conscious, alert, and oriented.

His vital signs:

He is apyrexial, his oxygen saturation is 96 percent in the room air, his heart rate **>220** beats/min, his blood pressure is 115/70 mmHg, and his respiratory rate is 22 breaths/min.

In the Cardiac and respiratory examination:

By inspection no scars no chest wall deformities no skin changes

By palpation, no mass, no tenderness, normal apex beat near the midclavicular line in the fifth intercostal space, no thrills, no heaves, the peripheral capillary refill was 2sec and femoral pulses are palpable, by auscultation tachycardia normal S1 S2 no added sounds or murmur and the chest is clear.

A full examination was done with no other positive findings.

Differential diagnosis

- Supraventricular tachycardia(SVT)
- Sinus tachycardia
- Atrial tachycardia
- Multifocal atrial tachycardia
- Junctional tachycardia
- Atrial flutter

Investigations

- CBC

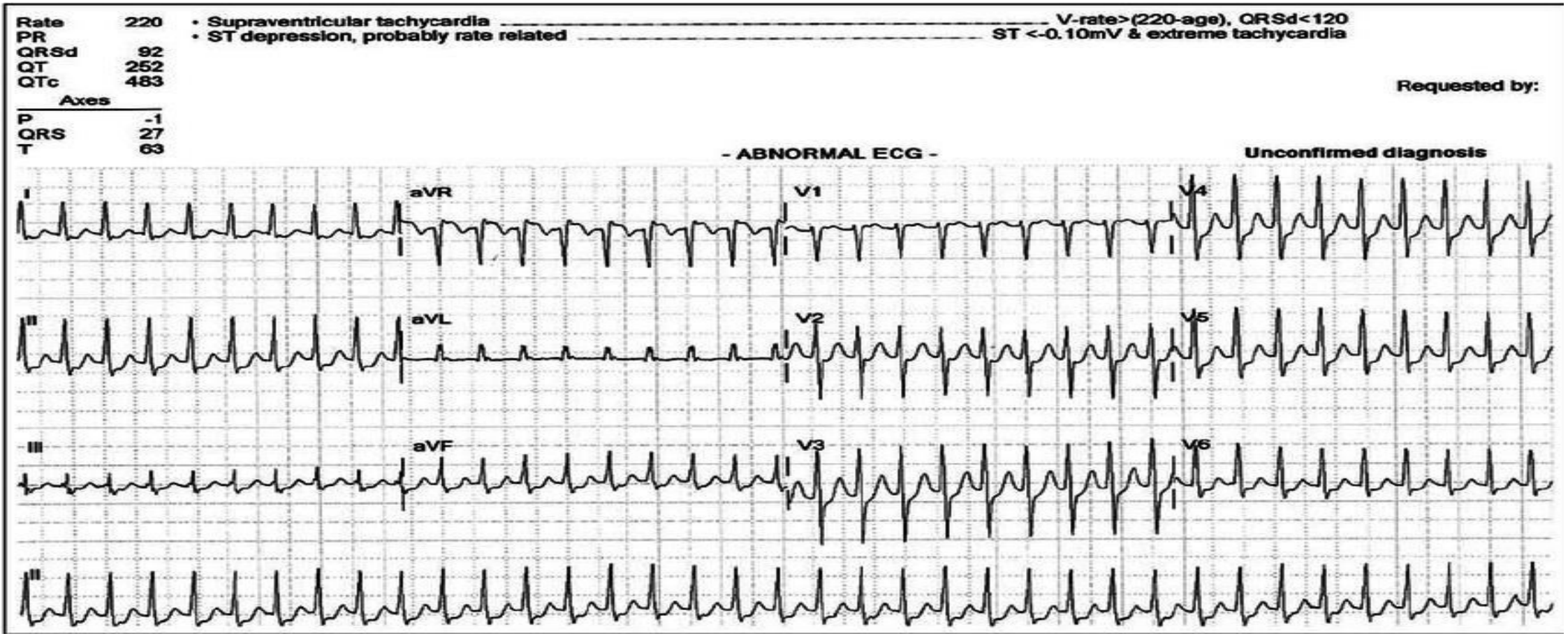
Hemoglobin 12 g/dL — Normal range (11.5–14.5 g/d)

MCV 80μm^3 — Normal range (76-90 μm^3)

White cell count 8.0 *1000/L — Normal range (4.0–12.0 * 1000/L)

Platelets 360 * 10^6/L — Normal range (150–400 * 10^6/L)

- ECG — The ECG shows a narrow QRS complex<(0.09sec) tachycardia with a rate of approximately 220 beats/min. There are no P waves
- Sodium 139 mmol/L — Normal range (135–145 mmol/L)
- Potassium 3.8 mmol/L — Normal range (3.3-4.6 mmol/L)
- Urea 5.7 mmol/L — Normal range (1.8–6.4 mmol/L)
- Creatinine 55 µmol/L — Normal range (20–80 µmol/L)
- C-reactive protein 0.4 mg/L — Normal range (0.06-0.79 mg/L)
- Echo — Normal
- Chest X-ray — Normal
- TSH 3.0 µIU/L — Normal range (0.5-4.5 µIU/L)



The ECG shows a narrow QRS complex<(0.09sec) tachycardia with a rate of approximately 220 beats/min. There are no P waves. So it is SVT

Management

- **ABCs**
- **In stable patients,**
  - Vagal stimulation by placing the face in ice water (in older children) or by placing an ice bag over the face (in infants).
  - vagal maneuvers such as the Valsalva maneuver, straining, or breath-holding
  - IV Adenosine by rapid intravenous push is the treatment of choice (0.1 mg/kg, maximum dose 6 mg)
  - Calcium channel blockers such as verapamil
- **In urgent situations,**

  when symptoms of severe heart failure have already occurred,
  - *synchronized* DC cardioversion (0.5-2 J/kg) is recommended as the initial management
- **Once the patient has been converted to sinus rhythm**,

  a longer-acting agent is selected for maintenance therapy such as
  - beta blocker, digoxin.
  - 24 hr electrocardiographic (Holter) monitoring
  - Catheter ablation

    radiofrequency

    cryoablation

Case 4

History

8-month-old male , presents to the emergency department with a complaint of sudden episodes of severe cyanosis and difficulty breathing. These episodes have been occurring intermittently over the past week and are becoming more frequent, increase in severity of episodes during feeding or crying. He diagnosed with Tetralogy of Fallot (TOF) shortly after birth. He was born one week later than his due date from an induced vaginal delivery. He breastfeeds every 3 hours, generally well, but sometimes takes a long time to feed. His immunizations are up to date

Physical examination

- General Appearance: Patient appears acutely ill, with central cyanosis.
- Vital Signs: Heart rate 160 bpm,respiratory rate 40 breaths per minute, blood pressure 90/50 mmHg, temperature (37°C),oxygen saturation 70% on blow-by oxygen.
- Growth Parameters: Weight is 6.5 kg, length is 68 cm , and head circumference is 43 cm .
- General inspection: He exhibits central cyanosis, with bluish discoloration of lips, tongue, and nailbed,no retractions,no grunting,no clubbing and neck viens are not engorged.

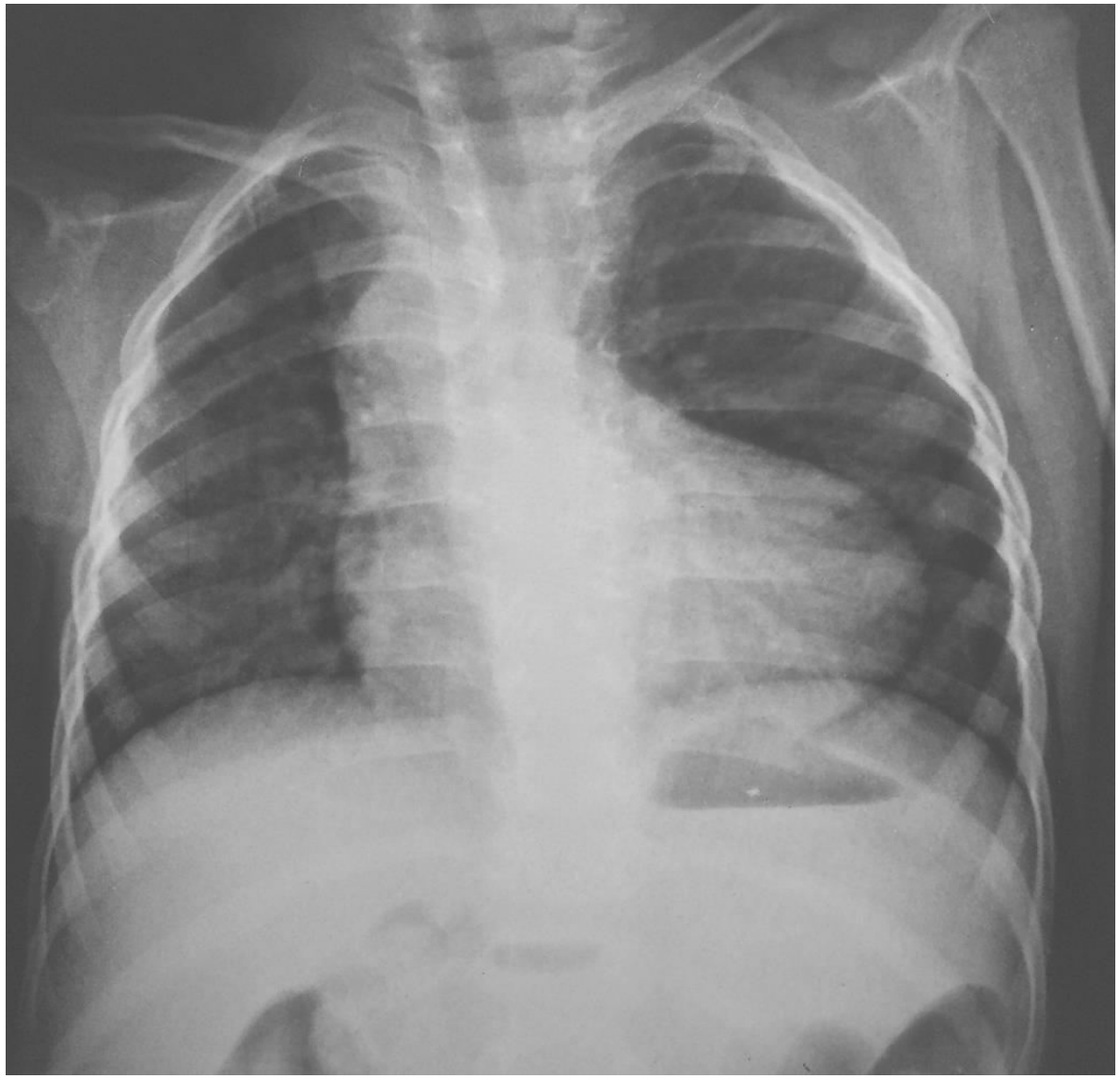
Cardiovascular examination

Inspection

- No visible apical impulse
- No visible pulsation
- No scars
- **Palpation**
- Apex beat palpable at left 5th intercostal space, at level of the mid-clavicular line
- Parasternal heave
- No thrills
- **Auscultation**
- A single loud S2 audible
- ejection Systolic murmur, best heard at left upper sternal border harsh in quality.

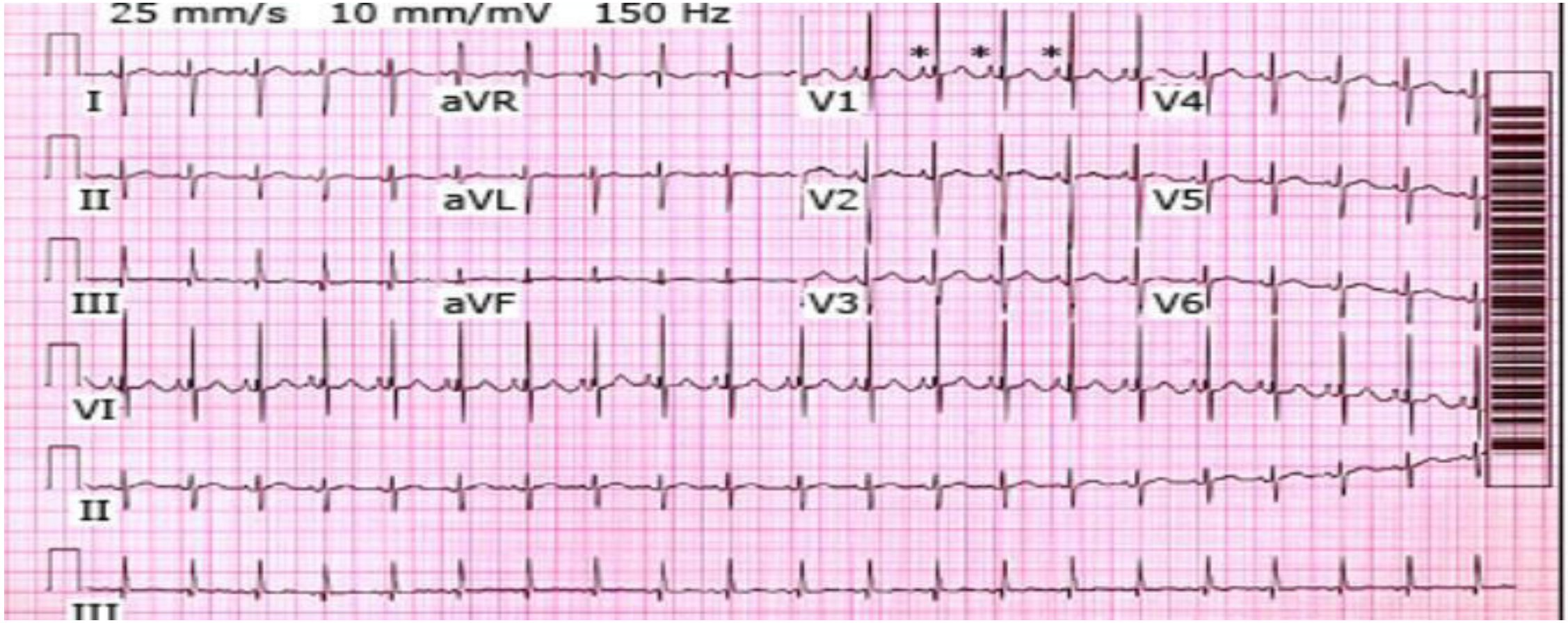
Investigation

- CBC
- ABG
- Echocardiogram:VSD,PS,RVH,overriding of aorta
- Chest x ray : Cardiac shape like wooden shoe,Oligemic lung,Large aorta



Electrocardiogram (ECG):

right axis deviation,right ventricular hypertrophy



Tetralogy of Fallot

This is a known case of tetralogy of Fallot, presenting to the ER during a tet-spell.

Children usually present with increased bluish discoloration and dyspnea, post crying or feeding or any added exertion.

Tetralogy of Fallot is the most common cyanotic congenital heart defect, representing about 10% of all congenital heart defects. There are four structural defects: ventricular septal defect (VSD), pulmonary stenosis, overriding aorta, and right ventricular hypertrophy

Management

- Calming and Knee-Chest Position
- 100%O2 therapy
- IV Fluid bolus
- correct metabolic acidosis (NaHCO3)
- Morphine sulfate, 0.2 mg/kg SC . (suppresses the respiratory center and abolishes hyperpnea.)
- phenylephrine (increase SVR)
- ketamine (increases SVR + sedative)
- propranolol (decreases HR)

Case 5

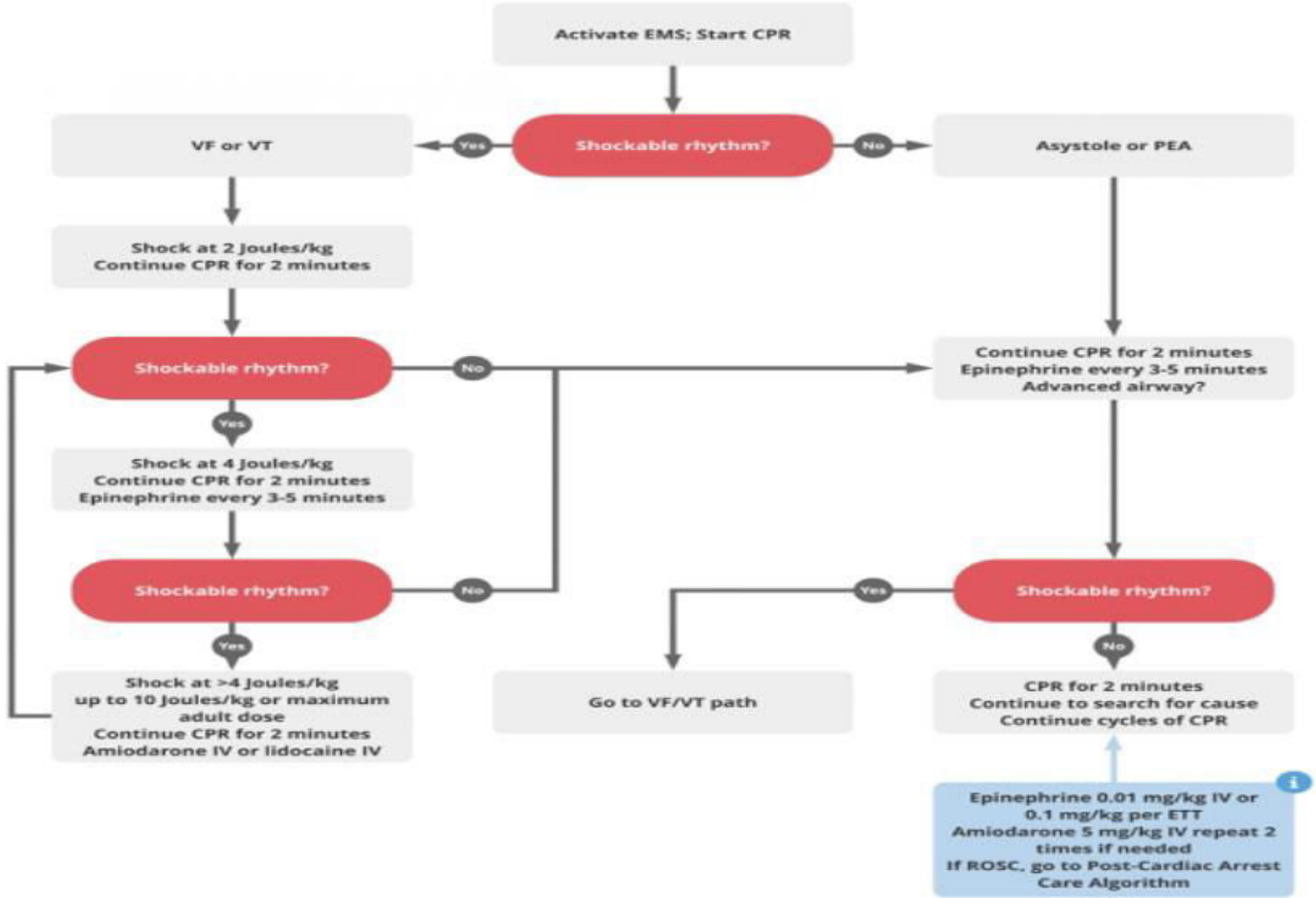
Aseel Mohammed is a 3 year old female inpatient in (PPH). She's a known case of pneumonia.
The mother called the nursing team after her daughter was playing with her toys then suddenly started chocking and coughing. (Code blue) was requested.

On Physical examination: unconscious, pallor, no breathing, non-audible heart sound, non palpable pulse.

Management

- If the patient was able to cough forcefully, then she should keep coughing.
- If the patient is chocking and cant talk, cry, or cough – forcefully, the red cross recommends the “five to five” approach to deliver in first aid.
- 1) Give 5 back blows. For a child, kneel down behind. Place one arm across the person's chest for support. Bend the person over at the waist so that the upper body is parallel with the ground. Deliver five separate back blows between the person's shoulder blades with the heel of your hand.
- 2) Give 5 abdominal thrusts. Perform five abdominal thrusts (also known as the Heimlich maneuver).
- 3) Alternate between 5 blows and 5 thrusts until the blockage is dislodged.
- If the patient is arrested, follow the PALS cardiac arrest alogarithm. (ACLS)

PALS Cardiac Arrest Algorithm



CPR quality

- **push hard and fast 1/3 anteroposterior chest diameter – 100-200 compressions/min**
- **allow complete chest recoil, and minimize the interruption in between compressions, and avoid excessive ventilation**
- **rotate compressor every 2 min or when fatigued.**
- **Compression to ventilation ratio : For pediatrics 15:2. For adult , single rescuer 30:2, for multiple rescuers 15:2**
- **Continuous compressions if advanced airways present , asynchronous ventilation for children, or timed ventilation in infants**

Investigation and work up specific for cardiac arrest:

- **Cardiac enzymes**: 1- Troponin 2-CPK
- **Blood tests** : potassium and magnesium
- **EKG**: to see the changes of the electrical activity in the heart
- **Echo ultrasound**
- **MRI**

Most common causes of reversible cardiac arrest

- **4 Hs / 5 Ts :**
- **Hypoxia / hypovolemia – (MC in pediatrics) / hydrogen ions excess (acidosis) / hypokalemia or hyperkalemia**
- **Tamponade/ toxins / tension pneumothorax / pulmonary thrombosis / coronary thrombosis**

Differential diagnosis:

- **Hypertrophic cardiomyopathy**
- **Tetralogy of fallout**
- **Ventricular fibrillation**

Thank you