



Identifying the Sick Child



Objectives

- * To explain importance of early recognition of **life threatening condition's mainly** respiratory failure and shock.
- * Identify which aspects of the physical exam should be included in the rapid assessment of the critically ill child.
- * Describe the clinical features of the different types of shock.
- * Discuss the early recognition of life threatening conditions & how to initiate management.

Care of the acutely ill or injured child

- * Requires rapid **quick assessment** and evaluation and **immediate management**
 - * different than that used to assess the well child or the child with a chronic or minor illness.
- * Centers on the **rapid identification of immediate stressing issue and focus on physiologic derangement** in organ-system function rather than the immediate development of a differential diagnosis **or cause**.

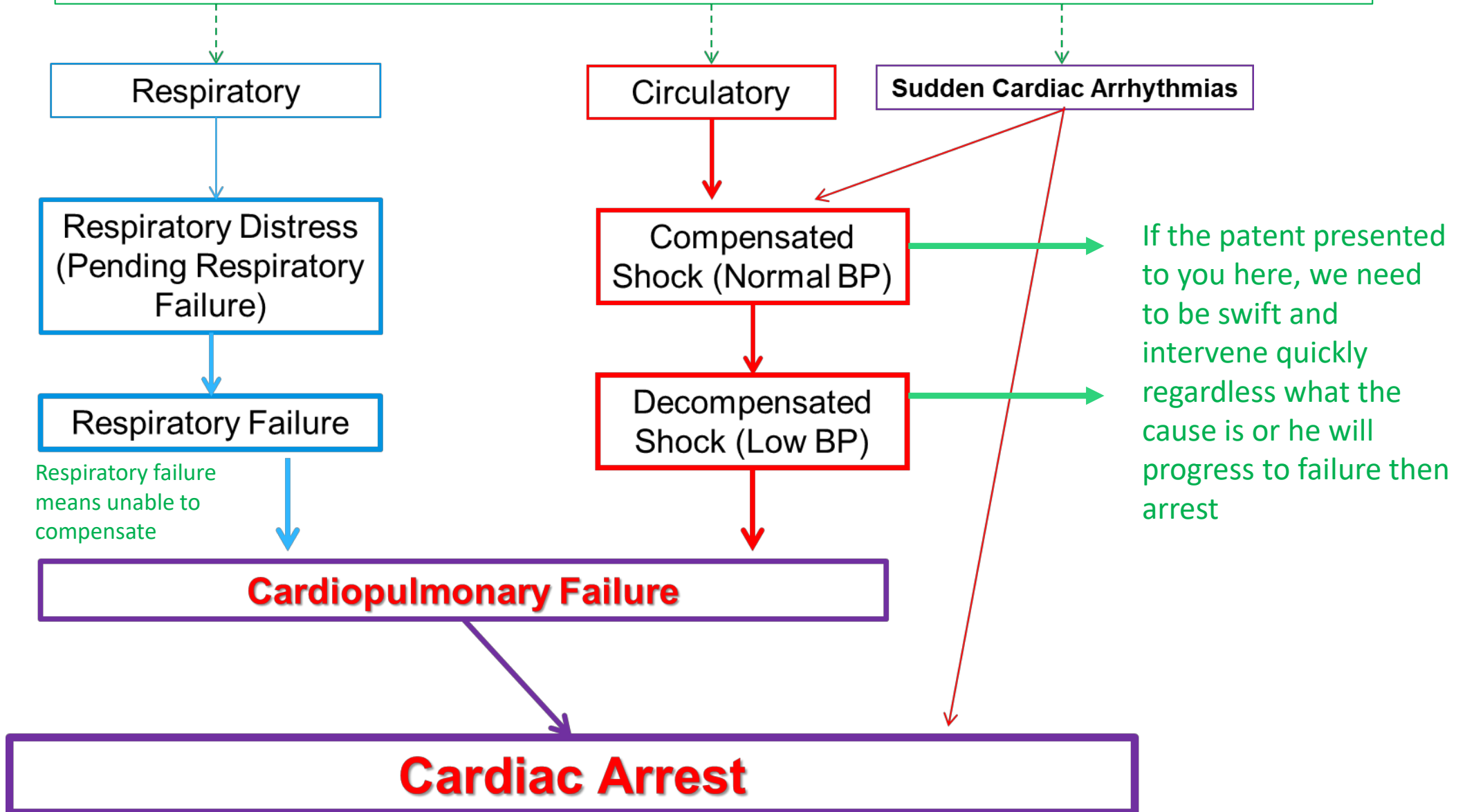
Diseases process itself is important but in this situations we don't need to identify the exact cause rather than to manage the child. And this is different from caring or assessing a stable child.

Example: Rapid identification of physiologic derangement, if he's come into with respiratory distress my main goal is not to diagnose it is it pneumonia or bronchitis is, my aim is to rapid identify his physiological derailments.

- * The goal of this efficient assessment is **triage and says is this patient stable or unstable and what kind of instability**, or identifying children at risk for critical illness or injury.
- * Because suspicion of critical illness warrants immediate management such as resuscitation, such action may need to be based on very limited information.

This is a broad common pathways of how do we reach to state of cardiac arrest then death. There is variable diseases and conditions that results in 3 possibilities (either sudden cardiac arrhythmias like ventricular tachycardia or ventricular fibrillation which then lead to cardiac arrest or it can be initiated by circulatory or respiratory causes.

Various Precipitating Conditions



Cardiopulmonary failure

- * Rarely a spontaneous event in children!
- * It's initiated by multiple diseases processes either infectious, poisoning, etc. and it is typically the **end result of progressively deteriorating respiratory or circulatory function.**
- * **Once cardiopulmonary arrest has occurred, the outcome is generally poor** not high at all, and even if there is response, they will suffer long acting neurological deficit
 - * **75 % dying**
 - * **75 % of the survivors sustaining permanent disability** (neurological deficit)

If you think about what is the function of cardio respiratory system, the function of the lung is to bring O₂ to the blood, and the function of the heart is to move the blood through the systemic circulation to the rest of organs and so on..

O₂ is important to generate energy in the body in forms of ATP's which are crucial for almost all biochemical reactions in the body and it's very important for the body functions

How to Categorize Patients

- * The initial evaluation of the acutely ill child requires rapid **and systematic and focused** cardiopulmonary assessment.
- * **You should be trained to do in any moment and it should** takes less than 60 seconds to complete
- * Follow the “PAT” (**pediatric assessment triangle**) and “ABCDE” approach

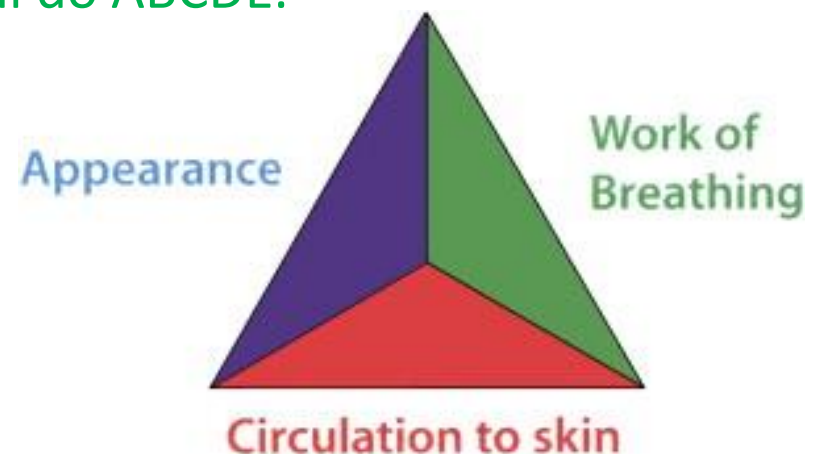
How to Categorize Patients

1. Pediatric assessment triangle ([PAT](#))

- Appearance = Conscious or unconscious
- Work of breathing = does he breath normally? Increasing, decreasing
- Circulation to skin = pink or not pink

It's the first impression about the patient (5 – 6 seconds) and will answer the questions about do I need code or I have time to do ABCDE

- Patient unresponsive, gray, not breathing → call code and ask for help "immediate Resuscitation" then you will do ABCDE.
- Patient is awake, pink, severe distrest → you will do ABCDE.



How to Categorize Patients

2. ABCDE approach:

A = Airway, is the airway patent and maintainable?

Patent means open and patient can breath through it, maintainable means he is able to maintain this airway patent and able to keep it patent

B = Breathing, what is the type of breathing, RR, saturation, lung sound.

C = Circulation, what is the skin color, perfusion, HR, BP, rhythm, and brain output.

D = Disability, obvious significant injury, level of consciousness, glucose.

E = Exposure, exposure the patient fully and look for any injury and measure temperature.

After doing the assessment triangle and ABCDE you should be able to categorize the physical state of the patient, is he in shock? What type of shock or is he in respiratory failure or distress or stable.

Triage

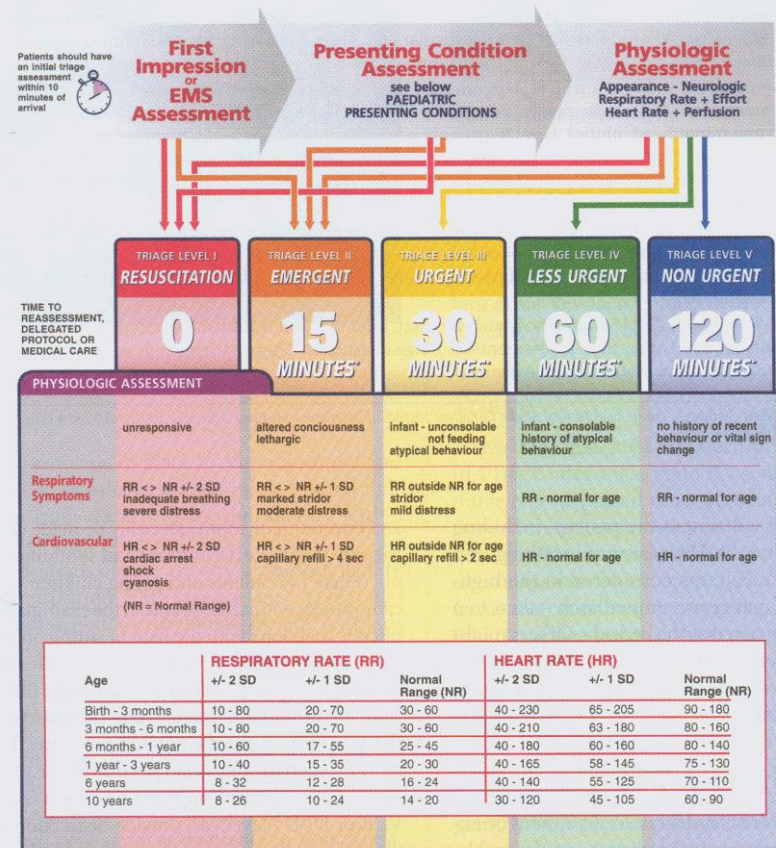
- * integrate pertinent physical findings and physiologic data into one of the following clinical impressions:
 1. Stable
 2. Impending respiratory failure or shock
 3. Definite respiratory failure or shock
 4. Cardiopulmonary failure
 5. Cardiopulmonary arrest

Triage example


Triage mean assessment of level of acuity in the ED, level of care that the patient need. In the Canadian system, they have 5 levels of triage and according to which level the patient is we determine when the patient is seen. Level 1: you should see the patient immediately and resuscitate him e.g. patient unresponsive, having inadequate breathing. Level 2: less urgent but still severe and urgent to see them. Level 3, 4 and 5: are cold cases that could wait. Lets assume we have a level 4 case that need to be seen in one hour but, the ED is very busy and there are many other more acute cases. What should we do? We will triage the patient again after assessed him again and takes his vitals and decide wither he will stay the same again or less or more (he will have a new triage and new level)



The Canadian Paediatric E.D. Triage and Acuity Scale



*TIMES TO ASSESSMENT are operating objectives, not established standards of care. Assessment objectives may be met using delegated protocols and remote communication.

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- * **Initial treatment is directed toward the physiologic derangement (e.g., shock)** rather than what might be the underlying cause (e.g., sepsis).

Respiratory failure

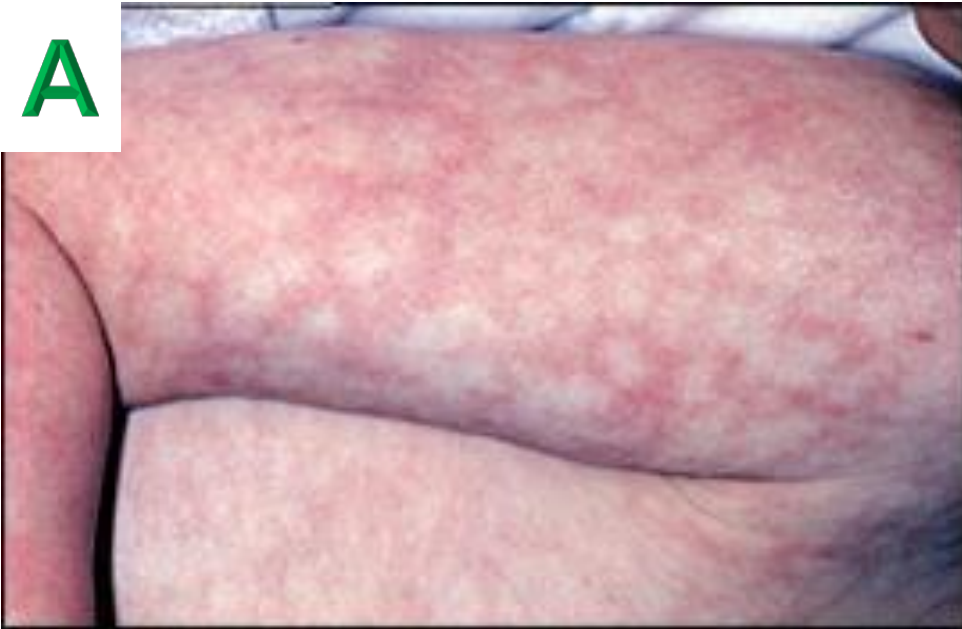
- * *The most common cause of cardiopulmonary arrest in children.*
- * Usually result in **Inadequate oxygenation and/or ventilation** and shock state eventually.
- * **May be caused** by intrinsic lung or airway disease, airway obstruction, or poor respiratory effort resulting from central nervous system dysfunction.
- * **Usually** preceded by respiratory distress, a compensated state characterized by signs of increased work of breathing (e.g., tachypnea, nasal flaring, intercostal muscle retraction, grunting, and accessory respiratory muscle use). All of them are signs of respiratory distress that require a quick intervention before respiratory failure occurs.

Shock

- * **A physiologic state with insufficient delivery of oxygen and metabolic substrates to meet the metabolic needs of tissues.** Shock means the heart and the lung or the body at large is unable to deliver oxygen to the tissue and cells, as we said before oxygen is very important and without it the body will go into anaerobic metabolism which means a compensated system that the body shifts to it if there is not enough oxygen but this is not efficient enough to sustain life so, there will be organ failure and death if we don't intervene.
- * We have clear signs of inadequate tissue perfusion depending on the organ that gets poorly perfused. E.g. skin: pallor, cool skin, poor pulses, delayed capillary refill. kidneys: oliguria, elevated creatinine and abnormal mentation. brain: delirium, confusion, lethargic, unresponsive. Heart: tachycardia, hypotensive.
- * Classified on the basis of the presence of a normal (compensated) or low (uncompensated) blood pressure.

Slides Quizz

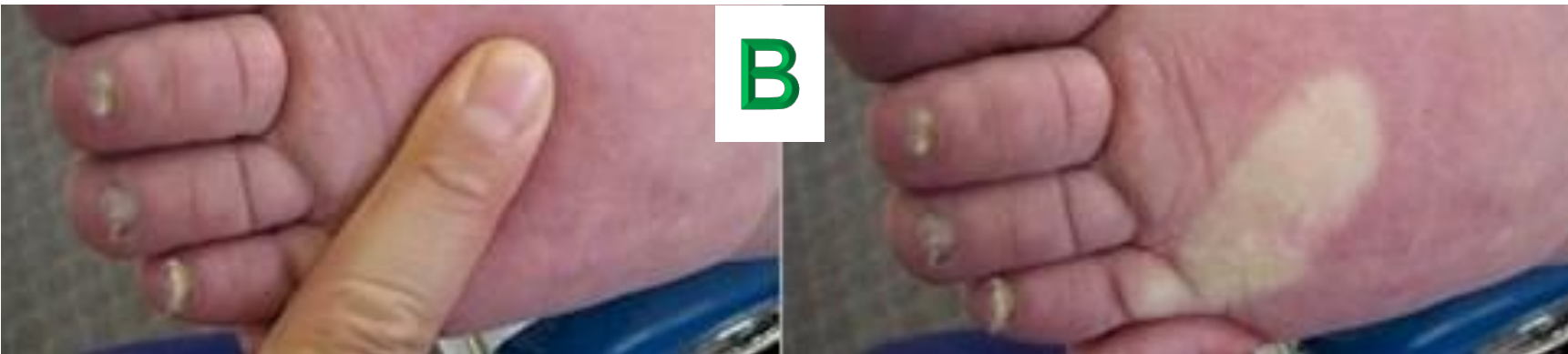
A



These are signs of shock

- A. **Mottling skin**, it reflects hypoperfusion to the skin sign of shock, the red skin is the normal and the white is the abnormal
- B. **Delayed capillary**, the normal up to 2 sec and it will fill again, however if more it's hypoperfusion and a sign of shock

B



Shock Type Type of shock mean the mechanism not the cause specifically	Primary Circulatory Derangement	Common Causes
Hypovolemic Tx: Bolus IV fluid (crystalloid such as NS) *10-20ml per kg within 20-30 minutes Usually we start with 20 ml/kg	Decreased circulating blood volume	Hemorrhage dehydration Diarrhea Diabetes insipidus (vomiting, diarrhea) Diabetes mellitus Burns Adrenogenital syndrome Capillary leak
Distributive Tx: Fluid + vasopressin (epinephrin)	Vasodilation --+ venous pooling --+ decreased preload Maldistribution of regional blood flow	Sepsis Anaphylaxis CNS/ spinal injury Drug intoxication

Shock Type Type of shock mean the mechanism not the cause specifically	Primary Circulatory Derangement	Common Causes
Cardiogenic Tx: Very little Fluid (5-10ml/kg) + Inotropes + treat cardiac problem	Decreased myocardial contractility	Congenital heart disease Severe heart failure Arrhythmia Hypoxic/ ischemic injuries Cardiomyopathy/Myocarditis Metabolic derangements Drug intoxication
Obstructive	Mechanical obstruction to ventricular outflow	Cardiac tamponade Massive pulmonary embolus Tension pneumothorax

In shock there is decrease Q2 delivery (DO2). How can we know the DO2?

Do2 = cardiac output (CO) × oxygen carrying capacity (CaO2)

Cardiac output (CO) = heart rate (HR) × stroke volume (SV)

Oxygen carrying capacity (CaO2) = $\{1.39 \times \text{Hb} \times \text{arterial oxygen saturation (SO}_2)\} + \{\text{partial pressure of oxygen (PaO}_2) \times 0.03\}$

The green part is the compounds form of oxygen “carried by hemoglobin“

The yellow part represents oxygens dissolved in the blood.

So, Oxygen delivery (Do2) = (HR × SV) × (1.39 × Hb × SO2)

للتسهيل الدكتور حذف جزء الاوكسجين المذاب بالدم بالتعويض في المعادلة

- Oxygen carrying capacity (CaO2) means how much available oxygen in the body for the heart to pump.
- Cardiac output (CO) means how the heart is efficient in pumping the oxygen. Also, represent the amount of blood volume that goes outside of the heart each minute.
- Stroke volume (SV) means the volume of blood that goes out of the heart with each beat. SV effect by many factors:
 - Contractility
 - Preload = end-diastolic volume
 - Afterload = tension, increase afterload leads to a decrease in the contractility



Lets apply the previous formula in the types of shock

$$\text{Oxygen delivery (Do}_2\text{)} = (\text{HR} \times \text{SV}) \times (1.39 \times \text{Hb} \times \text{SO}_2)$$

If anyone of them decrease and the rest is normal → DO₂ will decrease as well

1. hypovolemia: where is the problem? Preload
2. Cardiogenic: where is the problem? Contractility and HR
3. Obstructive: where is the problem? afterload
4. Disruptive: where is the problem? Preload! Because of vasodilation and venodilation that lead to venous return
5. Hemorrhagic : where is the problem? Preload and HB in acute bleeding

Compensated versus Hypotensive Shock

The minimum systolic blood pressures for age are: **imp**

Normally, there is variation in the vital signs depend on the age. E.g. the HR started high then decreases with age until reaches the adult age while the BP started lower than normal and then goes up and so on..

What is the minimum acceptable BP? Less than this is hypotensive

- Newborns to 1 month old: >60 **systolic BP** mmHg
- 1 month old-1 year old: >70 **SBP** mmHg
- $> 1-10$ years old: $(\text{Age} \times 2) + 70$ **SBP** mmHg

Ex: If we have 5 year old his normal bop should be > 80 $\{(5 \times 2)+70\}$

- 10 years: 90 **SBP** mmHg

Clinical signs of respiratory failure and shock

- * Caused by tissue hypoxia and the resulting metabolic or mixed (metabolic and respiratory) acidosis.
- * Early in the course of critical illness, respiratory failure and shock may be clinically distinct entities.
- * As both states progress, they deteriorate to a state of cardiopulmonary failure.
- * Irregular respiration, bradycardia, and hypotension are ominous findings in acutely ill children, suggestive of impending cardiopulmonary arrest.

Scenario 1

A 6-month-old girl is brought to ER following a 1-week history of nasal congestion, cough, wheezing, posttussive vomiting, tachypnea, and fever. On arrival to ER: vital signs: heart rate 180/min, respiratory rate 70/min, pulse oximetry 87% in room air, and temperature 38.7°C. She is tachypneic, grunting, retracting, and cyanotic.

What is this child's physiologic status?

- A. Stable
- B. Impending respiratory failure. Why? He has sign if respiratory diseases and high HR and RR, and low pulse oximetry. Why is not cardiopulmonary failure? Because he still has perfusion
- C. Impending shock
- D. Cardiopulmonary failure
- E. Cardiopulmonary arrest

Scenario 1: Respiratory

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On arrival to ER: vital signs: heart rate 180/min, respiratory rate 70/min, pulse oximetry 87% in room air, and temperature 38.7°C. She is tachypneic, grunting, retracting, and cyanotic.

* Does this patient exhibit signs of impending respiratory arrest?

Yes

* How will you manage this child? ABCDE (in B we will give non rebreather mask on 100% O₂ + bronchodilator then reassess)

Scenario 2

A previously healthy 4-month-old girl presents to ER with a 4-day history of vomiting, loose watery stools, and low-grade fever. She became lethargic 24 hours earlier and has refused to drink water or milk.

What is the likely etiology of shock in this scenario?

- A. Cardiogenic
- B. Obstructive
- C. Hypovolemic
- D. Distributive

Scenario 2: Shock

A previously healthy 4-month-old girl presents to ER with a 4-day history of vomiting, loose watery stools, and low-grade fever.

She became lethargic 24 hours earlier and has refused to drink water or milk.

- * Why is she lethargic? **Because she is in shock → Hypoperfusion to the brain**
- * What are other signs of shock that you might find? **Decrease skin turgor, pale and cold skin and all other signs of hydration, also you may find end organ damage signs (e.g. decrease urine output, high lactate, abnormal LFT)**
- * How will you manage this child? **ABCDE (in C we will secure two IV lines and give fluid, as a resuscitation for 4 months child we start with 20 ml/KG NS or RL if there is no cardiac concerns, if there is cardiac concerns we give 10 ml/kg, then we will calculate the deficit and maintenance and give it for him)**
- * If her initial serum Sodium level came to you as 170, how will you modify the Rx? **In this situation think in two ways:**
 1. **We give her the same fluid volume**
 2. **We decrease the amount of sodium so you give her hypotonic solution and divide it in two days (we don't want to drop too fast because of risk of cerebral edema)**

Scenario 3

Bader is 5 year-old boy, known to have asthma, on Ventolin inhalers as needed. He was brought to ER with 3 days history of cough & URTI. Today he developed shortness of breath and so he was given Ventolin inhalers & brought to ER.

His vital signs upon arrival: Pulse: 110/min, Respiratory Rate: 35/min, Temp: 36.5, Pulse Oxymeter 93% on room air. Chest exam reveals good air entry bilaterally with scattered wheezing.

What's your impression about his physiological status?

- A. Stable.
- B. Impending respiratory failure
- C. Impending shock
- D. Cardiopulmonary failure
- E. Cardiopulmonary arrest

Scenario 3: Respiratory

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- * How will you manage him in ER? Give Ventolin and steroids (treat the Asthma)
- * What advices will you give parents if he is sent home?
- * After 2 hours of ER stay, nurse informs you that the V/S are: Pulse 130, RR: 45, T: 37, O₂ Sat 88% on room air.
What is your next action? ABCDE (in B we give O₂) and we need to reassess the patient again to know what happen for him? is it pneumothorax, incorrect diagnosis etc.

Scenario 4

- * A 3-month-old girl with a history of a Ventricular Septal Defect, presented with a 1-week history of progressive tachypnea, diaphoresis, weight loss, and decreased urine output. Her mother indicates that she had run out of medication. Examination reveals that the child is grunting, tachypneic, and diaphoretic. She has a loud precordial murmur and an enlarged liver.
- * She will be sent from the clinic to radiology Dept for a CXR.

Your next step in management:

- A. Wait to see the CXR
- B. Send the child to the cardiology clinic the following week
- C. Give 20 ml/kg rapid bolus of Normal Saline over 10 minutes
- D. Give diuretics & consider inotropes. Because there is heart failure signs and symptoms

Scenario 4: Shock

- * A 3-month-old girl with a history of a Ventricular Septal Defect, presented with a 1-week history of progressive tachypnea, diaphoresis, weight loss, and decreased urine output. Her mother indicates that she had run out of medication. Examination reveals that the child is grunting, tachypneic, and diaphoretic. She has a loud precordial murmur and an enlarged liver.
- * She will be sent from the clinic to radiology Dept for a CXR.
- * Is sending her to do X-ray suitable? **No**, we should keep her in a close
- * monitored area and bring a portable X-ray
- * What other studies you may perform to confirm your diagnosis? **Echo**
- * How will you manage this child? **Give diuretics & consider inotropes**
- * What clinical signs would indicate a response to therapy? **Stable VS and resolution of signs (you will see clinical improvement)**

Scenario 5

- * A 2 year-old is brought to the ER 2 hours following ingestion of his grandmother medications. He is lethargic and becoming more drowsy. The parents do not know the medication name. Your colleague suggest to rush patient for gastric lavage.

A true response to your colleague is:

- A. Gastric lavage to be done after the first 4 hours of ingestion
- B. Inducing vomiting in the patient is faster & more effective than gastric lavage
- C. Lavage is surely indicated in corrosive ingestion
- D. **The priority now is to secure the airway.** Always start with ABCDE

Gastric lavage is not recommended any more in intoxication, we may give active charcoal within 1 hour and if there is risk of aspiration we don't give it.

Scenario 5: Airway

- * A 2 year-old is brought to the ER 2 hours following ingestion of his grandmother medications. **He is lethargic and becoming more drowsy.** The parents do not know the medication name.
- * What are your first priorities? **Airway**
- * How you will secure the airway? **Usually we can secure by definitive ways like Endotracheal tube or temporary like LMA, in this case we will use the definitive one which is endotracheal tube**
- * What advice you will give to the parents in the future? **Advice them to store medicines in designated places inaccessible to children**

Scenario 6

- * A 5-year-old boy is brought into PICU from a referring hospital where he presented 5 days ago with fever, swelling of the left knee, and redness. He was treated with ceftriaxone and acetaminophen. He became oliguric, tachycardiac, and hypothermic, and received 500 ml of normal saline prior to transfer. On arrival to the PICU he is found to be lethargic, hypothermic, hypotensive, and tachycardiac.

What is the likely etiology of shock in this boy?

- A. Cardiogenic
- B. Obstructive
- C. Hypovolemic
- D. **Septic.** How to differentiate between septic and obstructive? Septic has obstructive + cardiogenic + hypovolemic component

Scenario 6: Shock

- * A 5-year-old boy is brought into PICU from a referring hospital where he presented 5 days ago with fever, swelling of the left knee, and redness. He was treated with ceftriaxone and acetaminophen. **He became oliguric, tachycardiac, and hypothermic, and received 500 ml of normal saline prior to transfer. On arrival to the PICU he is found to be lethargic, hypothermic, hypotensive, and tachycardiac.**
- * What type of shock is this? Septic shock
- * How can you determine end organ perfusion? **Urine output, capillary refill, orientation, lethargy, level of consciousness, peripheral pulse**
- * How will you manage him? ABCDE

Scenario 7: Shock

- * A 5-year-old boy is brought into PICU from a referring hospital where he presented 5 days ago with fever, swelling of the left knee, and redness. He was treated with ceftriaxone and acetaminophen. **He became oliguric, tachycardiac, and hypothermic, and received 500 ml of normal saline prior to transfer. On arrival to the PICU he is found to be lethargic, warm, hypotensive, and tachycardiac. Capillary refill time is < 1 second (Brisk)**
- * What type of shock is this? Disruptive shock
- * How will you manage him?

Scenario 8

- * A 2-week-old girl arrives by ambulance to the ER from her home, where she was found to be apneic.
- * On arrival, her heart rate is 200/min and her blood pressure is 40/20 mm Hg in her right arm. She is pale and hypothermic with no palpable pulses in her lower extremities.

What is the hemodynamic status of this neonate?

- A. Normal
- B. Compensated Shock
- C. Hypotensive Shock
- D. Hypertensive

Scenario 8: Shock

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- * On arrival, her heart rate is 200/min and her blood pressure is 40/20 mm Hg in her right arm. She is pale and hypothermic with no palpable pulses in her lower extremities.
- * What is the etiology of shock in this scenario? **Coartication because of unpalpable pulse**
- * What other tests would you perform? **echo**
- * What medication should you immediately administer? **prostaglandins to open the duct so it will bypass the coartication**

Scenario 9

* A 3-month-old girl with history of colic is brought into the ER by a relative with a history that the infant apparently fell from her crib to the floor. On physical examination, she is unresponsive to stimulation. She has multiple bruises to the head, chest, and abdomen.

A true statement about this baby:

- A. the clinical findings are consistent with history provided.
- B. Multiple bruises on the body of infants are normal for hyperactive babies with colic
- C. Falling from the cribs is common for this age, especially if the side rails are left down
- D. The most important diagnosis to consider is non-accidental injuries

Scenario 9: Unresponsive child

- * A 3-month-old girl with history of colic is brought into the ER by a relative with a history that the infant apparently fell from her crib to the floor. **On physical examination, she is unresponsive to stimulation. She has multiple bruises to the head, chest, and abdomen.**
- * How would you describe this child's neurological status? **He is in coma**
- * How will you manage this case? **Skipped**

Scenario 10

A 4-year-old boy has been admitted to the ward with a diagnosis of uncomplicated pneumonia.

10 minutes after receiving the first dose of IV antibiotic, he starts complaining of tightness of his chest and not feeling well. Upon arrival to his bedside, he is unresponsive with labored breathing and audible wheezing. He appears flushed, has an urticarial rash, and swollen eyes. He is warm, tachycardic, and has bounding pulses. His blood pressure is 70/20 mm Hg.

What is your first treatment of choice?

- A. Corticosteroids IV
- B. Antihistamine IV
- C. Epinephrine IM
- D. IV Bolus of 20 ml/kg of Dextrose 10%

Scenario 10: Shock

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- * What is the etiology of shock in this scenario? **Anaphylactic shock**
- * What would be your immediate response? **Epinephrine**
- * How will you manage this patient? **Epinephrine**

Thank You!

Comments? Suggestions? Questions?

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