Recognition of the Seriously Ill Child

European Resuscitation Council

RECOGNITION AND INITIAL MANAGEMENT OF RESPIRATORY AND CIRCULATORY FAILURE

Aims and Objectives

- Aetiology of cardiac arrest in children
- Reducing mortality and morbidity
- Recognising respiratory and circulatory insufficiency and failure
- Initial management plan

Aetiology of Cardiac Arrest in Children (1)

Primary Cardiac Arrest

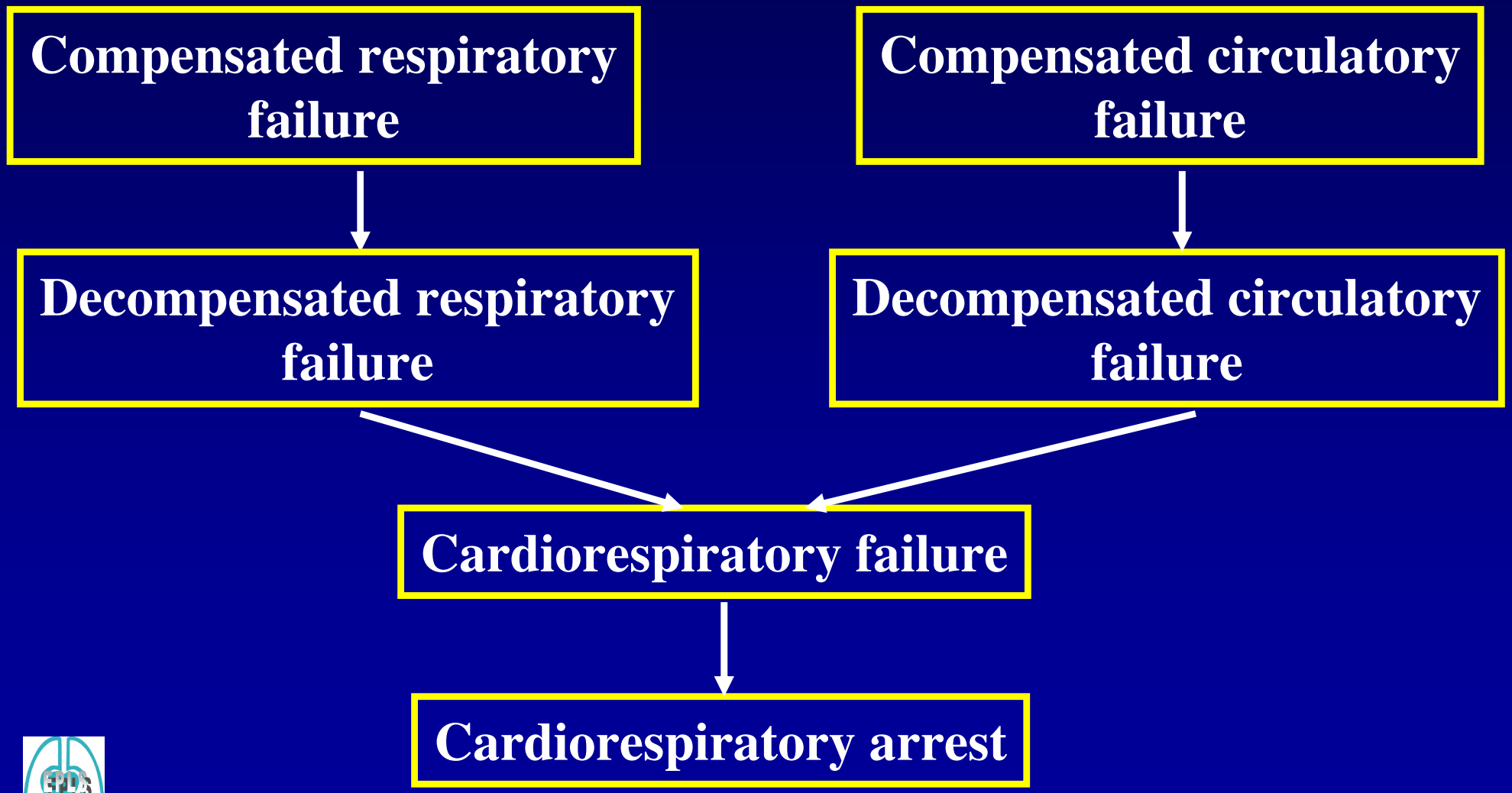
- Common in adults, less common in children
- Sudden, unpredictable onset
- Due to arrhythmia (VF or pulseless VT)
- Hypoxia and acidosis not initially present
- Outcome depends on early defibrillation

Aetiology of Cardiac Arrest in Children (2)

Secondary Cardiac Arrest

- Most common form in children
- Heart stops due to ischaemia or hypoxia secondary to another condition
- Arrest rhythm is usually bradycardia, progressing to asystole
- Hypoxia initially present
- Outcome depends on prevention or prompt resuscitation

Pathways to Cardiac Arrest in Children



Pathways to Cardiac Arrest in Children

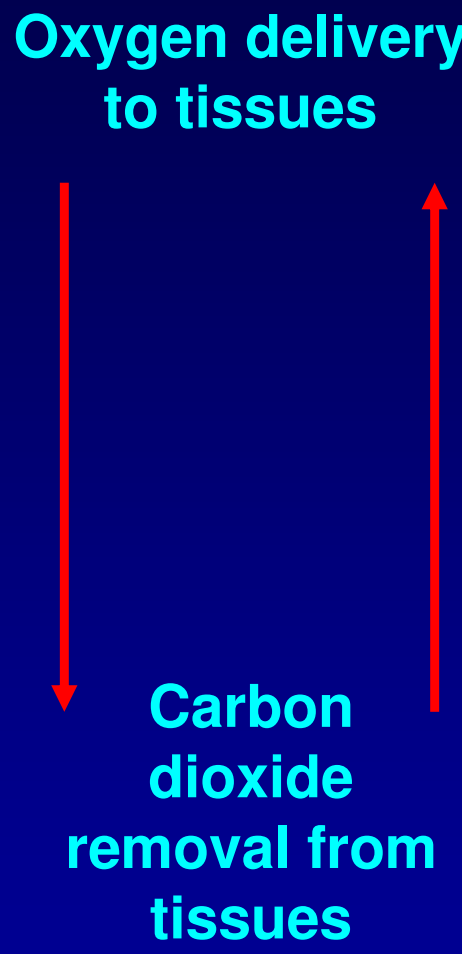
Successful resuscitation in children depends upon early recognition of respiratory and circulatory failure and measures to prevent progression to cardiac arrest

What is wrong with these children?

A - Airway

B - Breathing

C - Circulation



Assess, change, reassess

Respiratory Failure:
Definitions

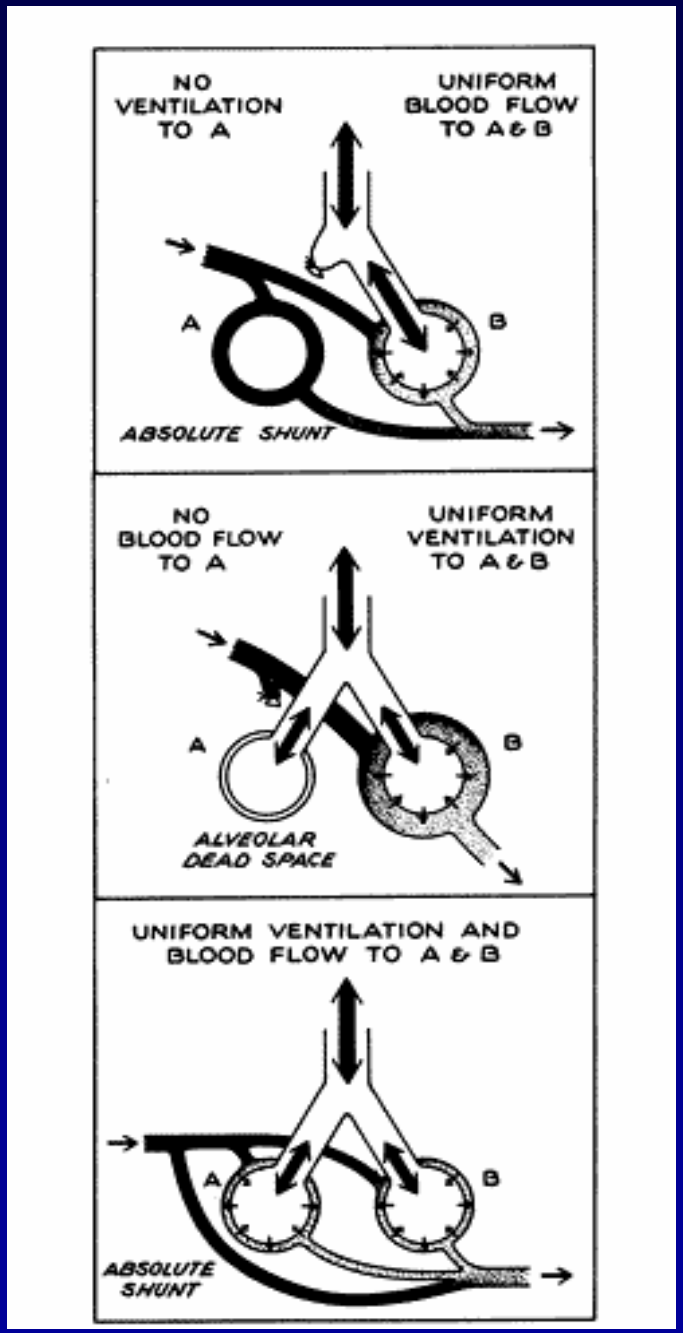
Respiratory failure

- The loss of ability of the respiratory system to maintain adequate blood levels of CO_2 and O_2

Respiratory distress

- Clinical state with increased work of breathing

Respiratory failure can exist without respiratory distress



Pathophysiology of Respiratory Failure (1)

Due to mismatch of ventilation and perfusion in lung units

Pathophysiology of Respiratory Failure (2)

Due to inadequate movement of gas in and out of the lungs

Minute ventilation = Tidal volume x resp rate

1400ml/min	140ml	10/min
1400ml/min	70ml	20/min
1400ml/min	35ml	40/min

Respiratory failure can occur with respiration which is either too slow *or* too fast

Assessment of Respiratory Insufficiency

A B C

Assess, change, reassess

Assessment of Respiratory Insufficiency: Airway

- Chest movement does not imply a clear airway
- Listen and feel for air movement and noises

Is the airway:

Clear and safe?

At risk?

Obstructed?

Assessment of Respiratory Insufficiency: Breathing

- Respiratory rate
- Tidal volume
- Work of breathing
- Oxygenation

Assessment of Respiratory Insufficiency: Breathing

Respiratory rate:

Varies with age, fever, pain and anxiety as well as respiratory insufficiency

Age	<1	2-5	5-12	>12
Resp rate	30-40	20-30	20-24	12-20

It is more important to monitor the trend in respiratory rate than to rely on the absolute value

Assessment of Respiratory Insufficiency: Breathing

Tidal volume; look, listen, feel

- Compare one side with the other
- Subjective assessment; breath sounds should be audible in both bases
- Feel for the trachea; is it central?
- Noises!

Assessment of Respiratory Insufficiency: Breathing

Noises

- **Stridor:** Inspiratory noise; airway obstruction above the thoracic inlet
- **Wheeze:** Expiratory noise; airway obstruction below the thoracic inlet
- **Grunting:** Expiratory noise; attempt to raise the end-expiratory lung volume

Signs of Respiratory Distress
(increased work of breathing)

- Tachypnoea
- Recession
- Head bobbing
- Anxious demeanour
- Flared nostrils
- Grunting
- Stridor or wheeze
- Exhaustion

Assessment of Respiratory Insufficiency: Oxygenation

Cyanosis is an unreliable sign of hypoxia

- Absence of cyanosis does not imply good oxygenation
- Central cyanosis does imply hypoxia
- Use a pulse oximeter
- What FIO_2 is required to maintain good saturations?

Compensated or Decompensated?

Signs of decompensation

- Increasing respiratory rate
- Respiratory rate <10 or >55
- Sudden fall in respiratory rate
- Reduced interaction with carers
- Exhaustion
- Decreasing level of consciousness

What is wrong with this child?

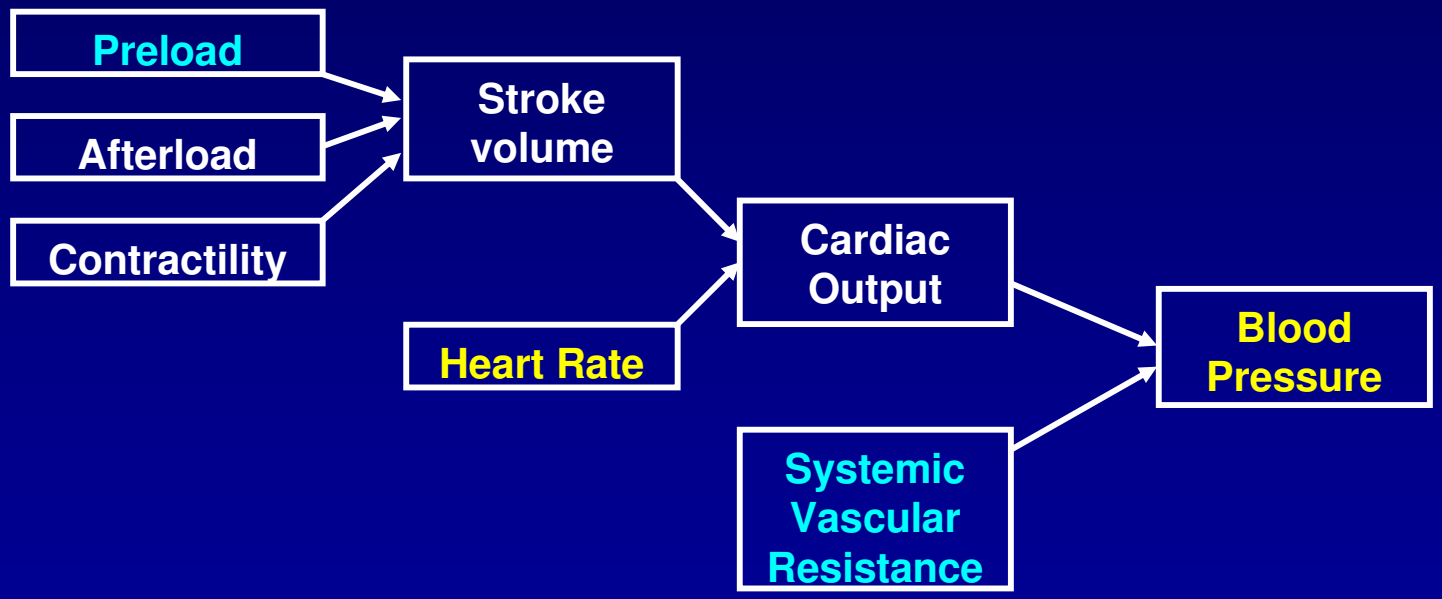
Assessment of Circulatory Failure

A B C

Assess, change, reassess

Assessment of Circulatory Failure

Relationships between variables affecting cardiac output and blood pressure



Can be objectively measured

Can be subjectively assessed

Assessment of Circulatory Failure

- Heart rate
- Blood pressure
- Systemic vascular resistance
- Pre-load

Assessment of Circulatory Failure: Heart Rate

Heart rate:

Varies with age, fever and anxiety as well as circulatory failure

Normal heart (HR) and respiratory (RR) rates by age

Age	>30 days	5 years	12 years	18 years
RR	30	20	18	14
		X5	X5	X5
HR	130	100	90	70

Assessment of Circulatory Failure: Blood Pressure

Changes in systolic blood pressure with age

Age	Systolic BP (normal) mmHg	Systolic BP (lower limit) mmHg
0 –1 month	60	50
1 – 12 months	80	70
1 – 10 years	90 + 2x age	70 + 2x age
> 10 years	120	90

Assessment of Circulatory Failure: Blood Pressure

Blood pressure is maintained by increases in SVR at the expense of perfusion of:

- **Skin**
- **Kidneys/gut**

When compensatory mechanisms fail, BP falls. Prior to cardiac arrest so dose perfusion of:

- **Brain & heart**

Assessment of Circulatory Failure: Skin Perfusion

Capillary refill

- Gently squeeze a finger (or toe) pulp until it blanches
- Release and observe the return of capillary blood
- > 2 seconds is abnormal

Assessment of Circulatory Failure: Skin Perfusion

- **Look** – for colour (mottling, pallor, peripheral cyanosis or rashes)
- **Feel** - for peripheral pulses, temperature and the line of demarcation between warm and cold

Assessment of Circulatory Failure: Renal Perfusion

Urine output is an index of organ perfusion

- **Nappy weights**
- **Urinary catheter?**

Assessment of Circulatory Failure: Pre-load

- Jugular venous pulsation
- Enlargement of liver
- Moist sounds in lungs
- CXR

Compensated or Decompensated?

Signs of decompensation

- Increasing pulse rate
- Sudden fall in pulse rate
- Hypotension
- Oliguria
- Reduced interaction with carers
- Decreasing level of consciousness

Types of Circulatory Failure

	HR	BP	SVR	Pre-load
Hypovolaemic	↑	→	↑	↓
Distributive	↑	↓	↓	↓
Cardiogenic	↑	↓	↑ →	↑ →

Cardiorespiratory Failure

- There is always some respiratory compensation for circulatory failure and vice versa
- In severe illness it is not possible to determine which came first
- If untreated, this phase presages imminent cardio-respiratory arrest

Management; based on initial assessment

- Stable and safe
- Compensated respiratory failure
- Decompensated respiratory failure
- Compensated circulatory failure
- Decompensated circulatory failure
- Cardio-respiratory failure

Compensated Respiratory Failure

- Assess airway
- O_2 therapy (unthreatening)
- Monitoring (pulse oximetry, pulse and respiratory rate)
- IV access with topical anaesthesia
- Reassess

Decompensated Respiratory Failure

- Maintain clear airway
- 100% O_2
- Support ventilation with bag/mask system
- Consider tracheal intubation and mechanical ventilation

Compensated Circulatory Failure

- Assess airway
- O_2 therapy (unthreatening)
- Monitoring (pulse oximetry, pulse and respiratory rate, blood pressure)
- IV access
- Fluid bolus
- Reassess

Decompensated Circulatory Failure

- Airway control
- 100% O_2
- Support ventilation if required
- Urgent IV/IO access, fluid bolus
- Reassess and repeat as required
- Consider inotropes

Cardiorespiratory Failure

- Airway control
- 100% O_2
- Support ventilation, initially with bag/mask system
- Reassess (monitoring)
- Urgent IV/IO access; fluid boluses if required
- Reassess
- Consider inotropes

Example 1

9 month old with "breathing difficulty".

On admission; respiratory rate 45/min, heart rate 160/min, temperature 37.8^{0}C. Conscious and fully orientated

A: Clear

B: Generalised wheeze both lungs, increased work of breathing

C: Tachycardia, BP normal, good peripheral perfusion

Compensated respiratory failure

Example 1
Management?

- O_2 therapy (unthreatening)
- Monitoring (pulse oximetry, pulse and resp rate)
- IV access with topical anaesthesia
- Reassess regularly

Other Investigations

- CXR?
- FBC & Electrolytes?
- Blood gases?

Onward referral

Example 2

11 month old with 2 day history of "colic". On admission; respiratory rate 40/min, heart rate 185/min temperature 37.2^{0}C. Drowsy and withdrawn

A: Clear

B: Good air entry bilaterally, tachypnoea, quiet respiration

C: BP 65/?, cool mottled peripheries, capillary refill time 5 seconds, dry nappy

Decompensated circulatory failure

Example 2
Management?

- Airway control
- High flow O_2
- Support ventilation if required
- Monitoring (minimum SpO_2 and BP)
- Urgent IV access, fluid bolus
- Reassess and repeat as required

Example 2
Fluid boluses

20ml/kg

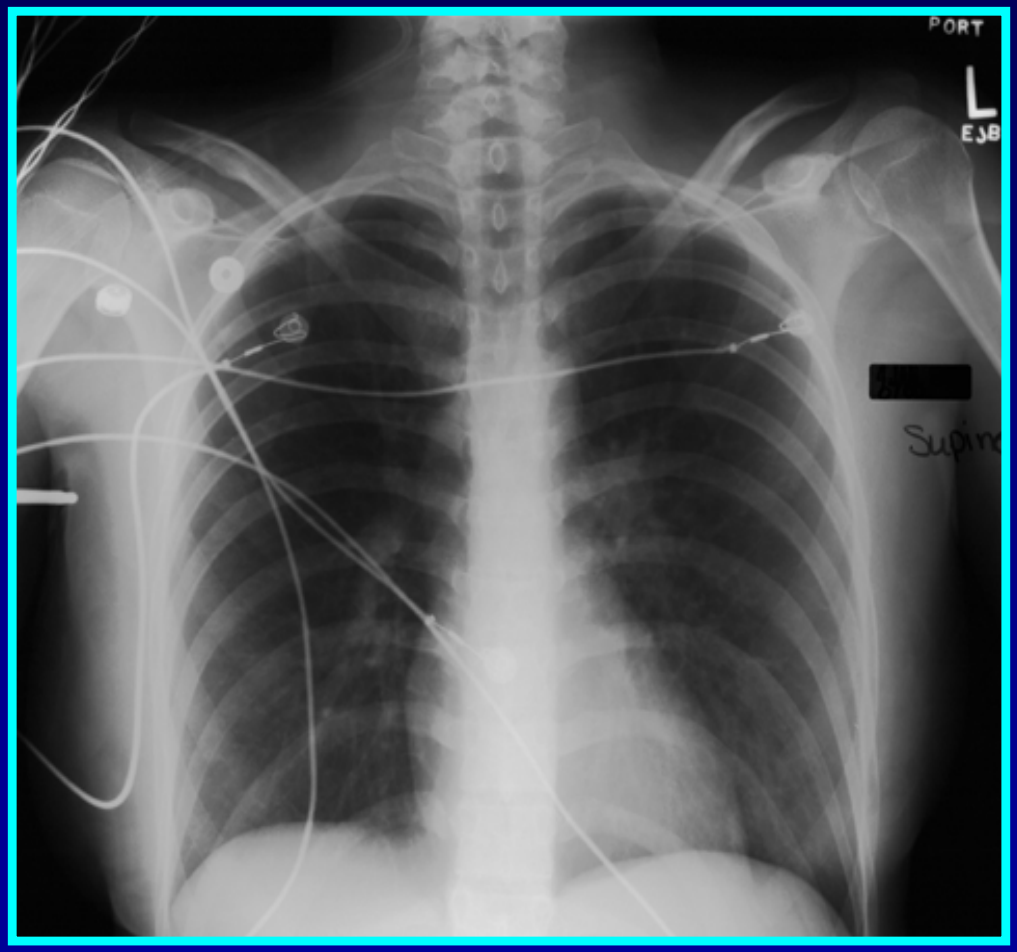
Balanced salt solutions initially (e.g. 0.9% NaCl, Compound Sodium Lactate)

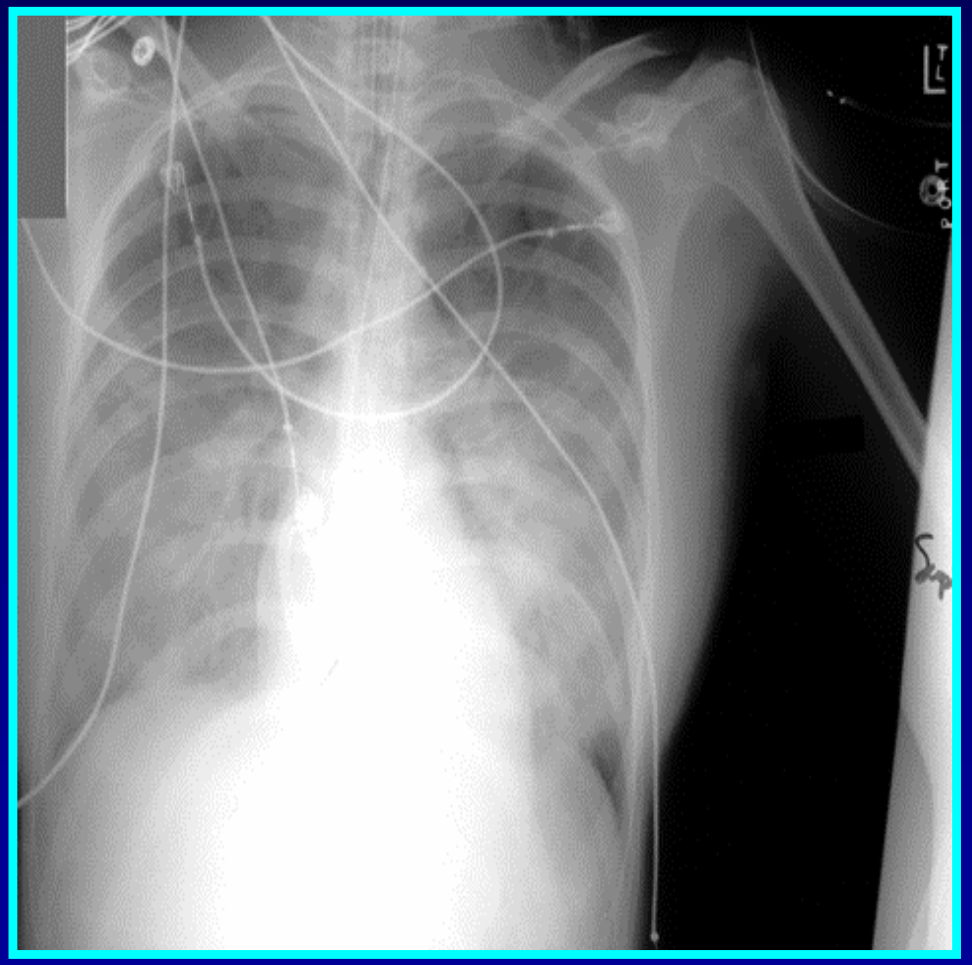
Reassess

Assessment of Fluid Boluses

- Changes in heart rate, BP, peripheral perfusion
- Chest signs
- Jugular venous pulsation, liver edge
- CXR

Chest X-Ray





Other Investigations?

- CXR
- FBC, X-match & Electrolytes
- Blood gases

Onward referral

Summary

- Prevention of cardiac arrest is the best way of reducing mortality and morbidity
- ABC
- Assess, change, reassess