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Educating, Training and Setting Standards in
Anaesthesia, Critical Care and Pain Management



Anaesthesia for non-cardiac surgery for patients with congenital heart disease

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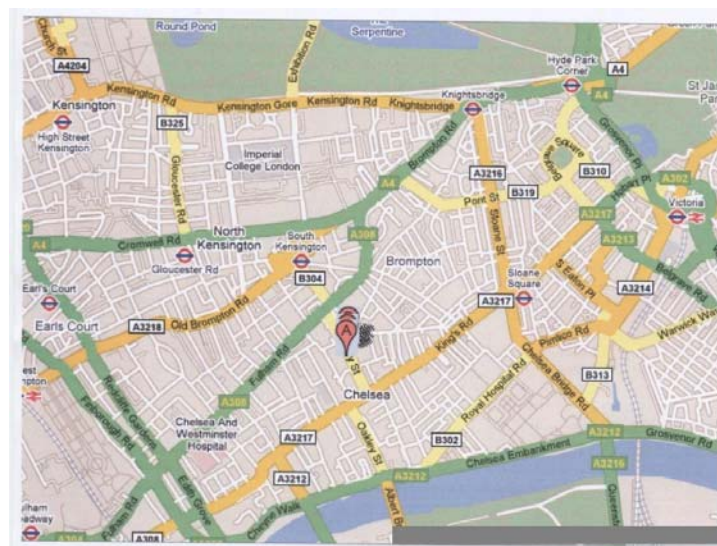


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Adult Congenital Heart Disease





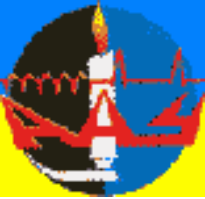
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Non-cardiac procedures in ACHD

- Primarily to manage cardiac condition
 - Airway / Thoracic procedures to avoid hypoxia
- Manage non-cardiac conditions which with increased survival now occur
 - Pregnancy
 - Labour
 - LSCS
 - Emergency conditions
 - Conditions of aging



Range of disease

- Too much blood to lungs (e.g. ASD, VSD, PDA)
 - ↑ flow / pressure to pulmonary vasculature
 - Chronic effects
- Too little blood to lungs (e.g. ToF, TGA, Truncus, HLHS)
 - ↓ S_aO_2 in blood to tissues
 - Cyanotic heart disease
- Too little blood to the body (e.g. CoA Ao, HLHS)
 - ↓ blood flow to tissue
- Electrophysiological issues
- Coagulation issues

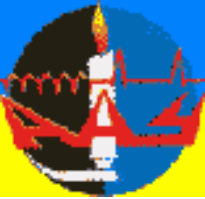


Cyanotic patients – Anaesthetic issues



Too little blood to lungs

- Balanced Circulations
- Pulmonary Hypertension (PHT)



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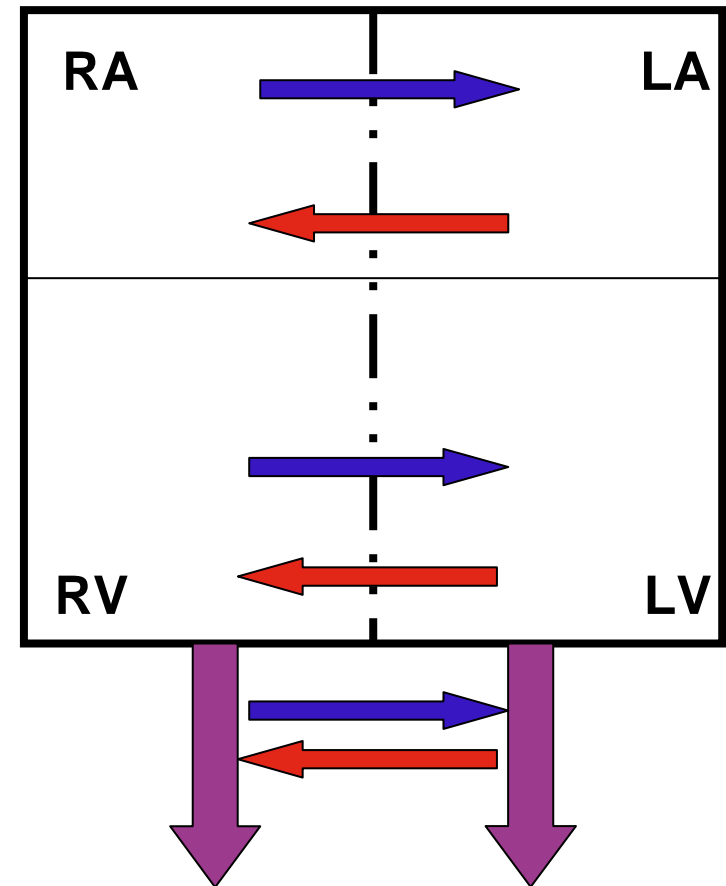
Balanced circulations

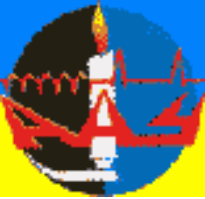
- What is a balanced circulation?
- Principles to manage balanced circulations
 - Hypoxia
 - Hypotension



What is a balanced circulation?

- Blood mixes between right & left sides of the heart
- Saturation of systemic blood flow will depend upon:
 - Proportion of blood passing through lungs
 - Degree of mixing of blood





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Principles when managing balanced circulations

- Maintain patient's own 'normal' level of oxygenation
 - S-P shunt $\text{SaO}_2 \sim 70\%$
 - Glenn circulation $\text{SaO}_2 \sim 80\%$
- Provides balance of:
 - Oxygen carriage
 - Blood flow to tissue
- Allows their normal activity



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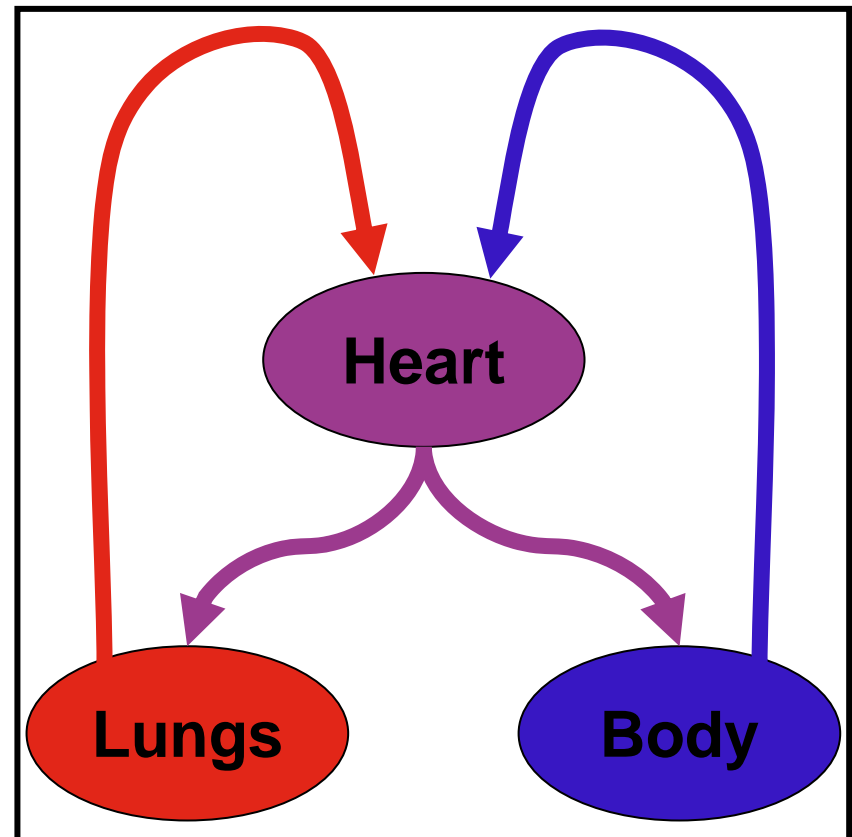


Flow in balanced circulations

$$Flow = \frac{\pi \Delta P (r)}{8 \eta l}$$

P = pressure
r = radius

η = viscosity
l = length



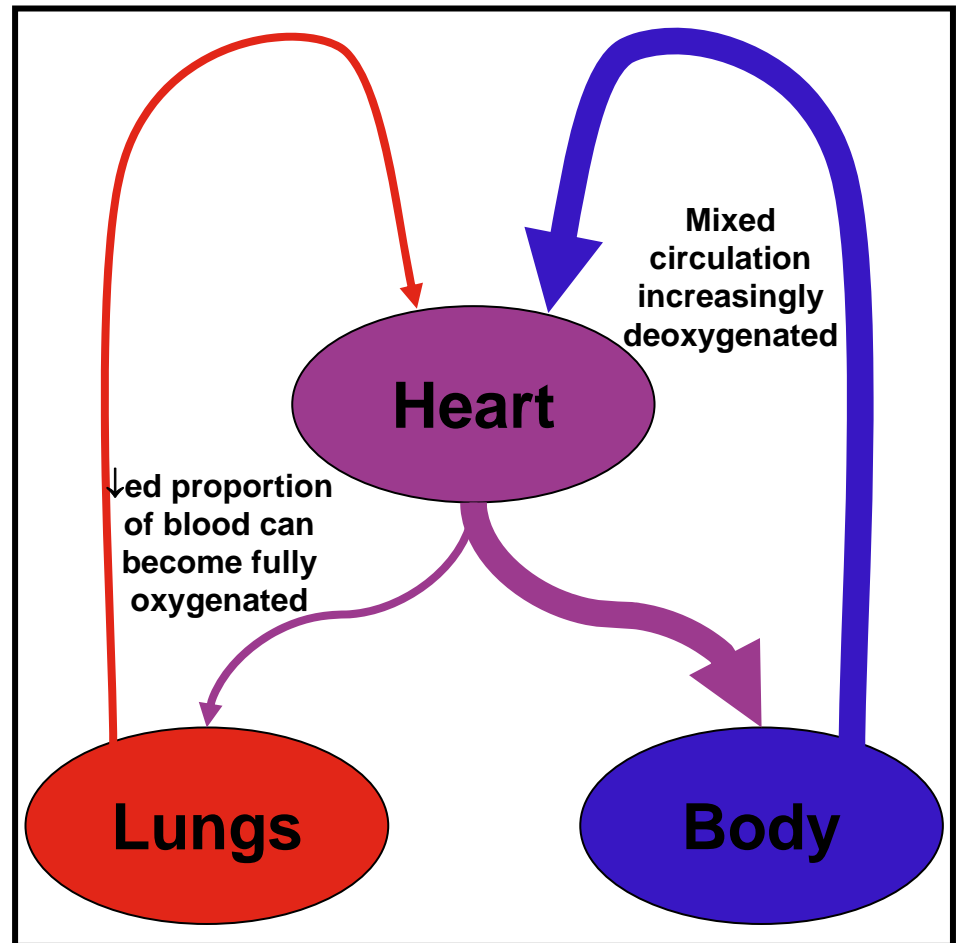


Hypoxia in balanced circulation

- All usual causes
 - Inadequate O₂ supply
 - Ventilation failure
- Unbalanced circulation
 - ↓ SVR
 - ↑ PVR

Treatment

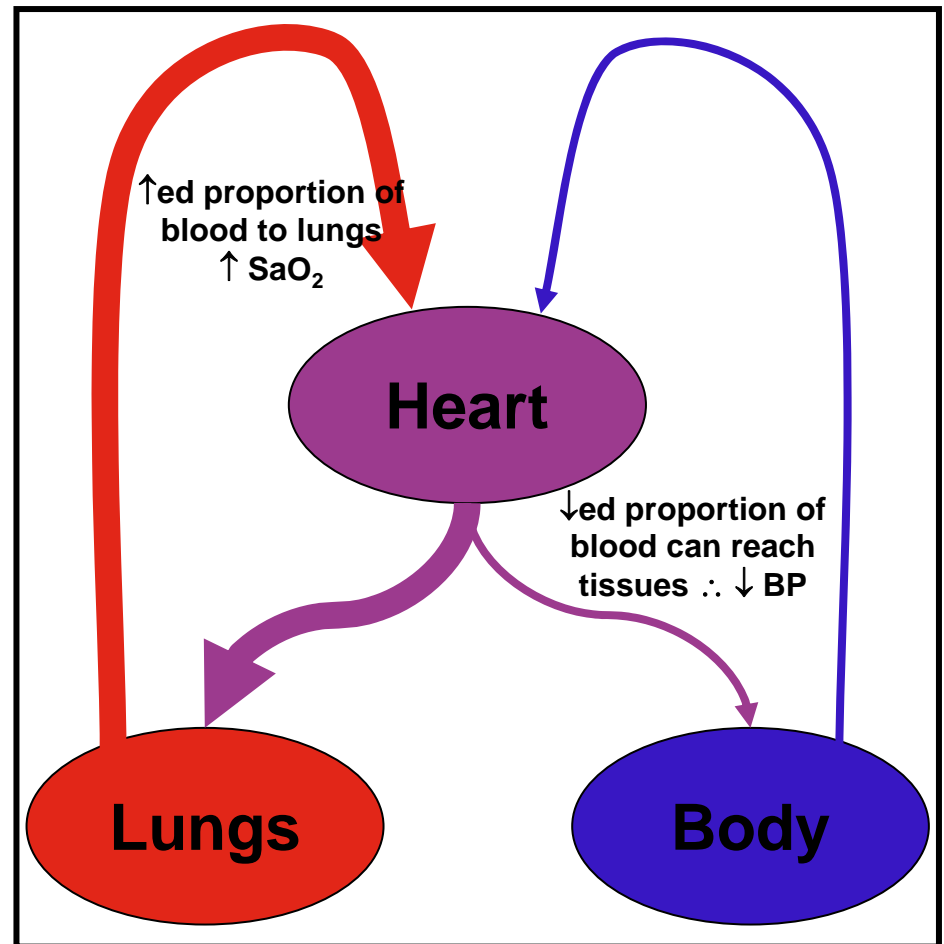
- Re-balance circulation
 - Vasoconstrictors
 - Oxygen
 - Hyperventilation

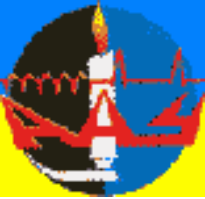




Hypotension in balanced circulation

- All usual causes:
 - Hypovolaemia
 - Ventricular failure
 - Loss SVR
 - Unbalanced Circulation
 - \downarrow PVR
 - Outflow obstruction
- Treatment
- Rebalance circulation
 - $\downarrow F_i O_2$
 - Allow CO_2 to rise



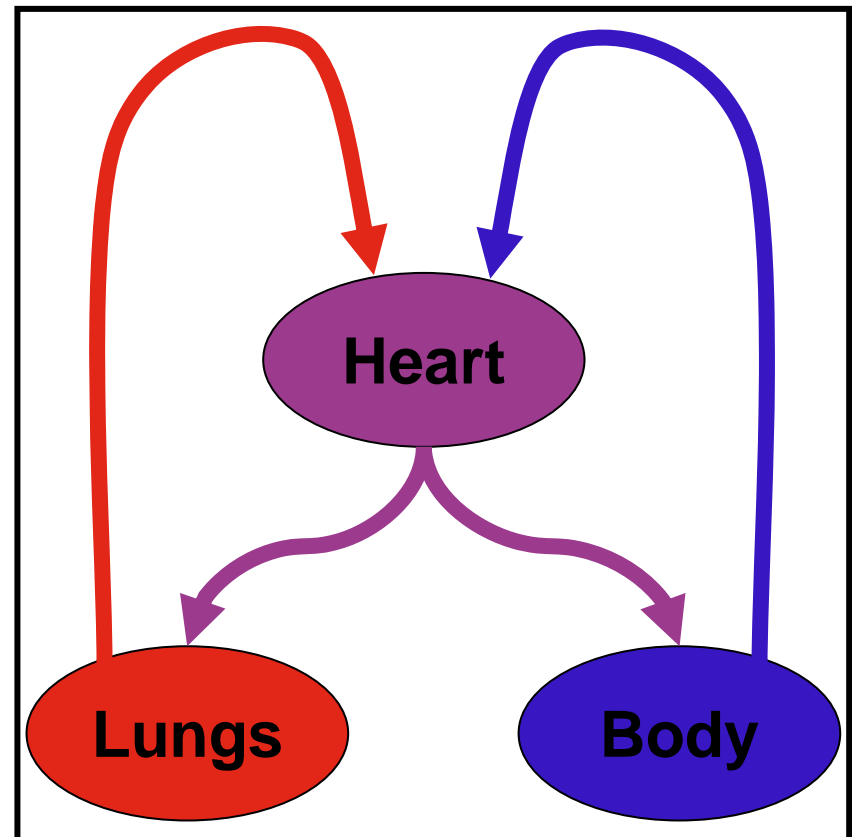


Balanced Circulation Summary

- Consider 1st principles when anaesthetising these patients

$$Flow = \frac{\pi \Delta P (r)}{8 \eta l}$$

- SaO₂ & PaCO₂ profoundly affect flow
 - Maintain at normal for the individual





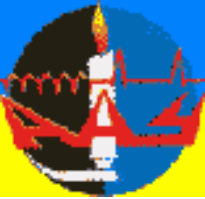
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Pulmonary Hypotension

- What is PHT?
- The risk of PHT to the anaesthetist
- Managing PHT:
 - During anaesthesia
 - During a pulmonary hypertensive crisis



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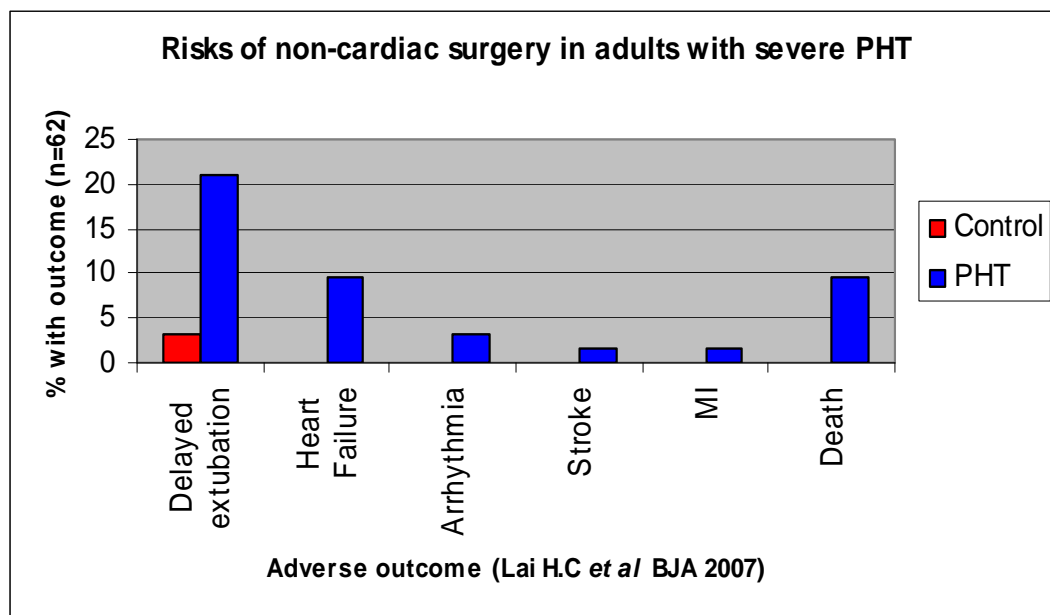
What is pulmonary hypertension?

- Pulmonary artery pressure
 - > 25mmHg at rest
 - > 30mmHg on exercise
- May occur 2^o to:
 - Congenital Systemic-Pulmonary shunts
 - Simple congenital heart disease e.g. PDA, ASD, VSD
 - Complex congenital heart disease
 - Left heart disease
 - Lung disease



Risk associated with PHT

Risk Factors



- NYHA ≥ 2
- Emergency Surgery
- Intermediate / High risk surgery
 - Head & neck
 - Intra-thoracic
 - Intra-peritoneal
 - Joint replacement
 - ORIF
 - Prostatectomy
- Anaesthesia > 3hrs



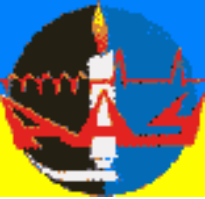
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Principles when managing PHT

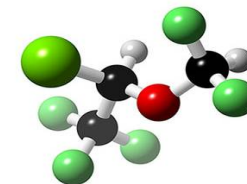
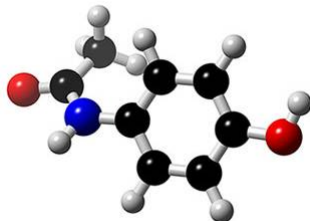
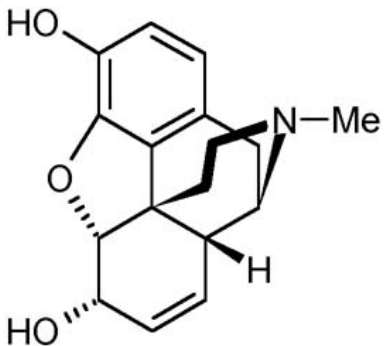
- Recognise the potential
 - ↑ed pulmonary blood flow (L-R shunt)
 - Pulmonary vein obstruction (1^o or 2^o)
- Manage this potential
 - Remember may occur up to 3 days post-GA



Anaesthetists avoid increased PVR

Causes ↑ed PVR

- Alveolar hypoxia
- Hypoxaemia
- Acidosis
 - Metabolic
 - Respiratory ($\uparrow P_a\text{CO}_2$)
- Sympathetic activity
 - Pain
 - Awareness





Increased PVR occurs post-op

Causes late 2^o ↑PVR

- Hypoventilation
 - Particularly nocturnal
- Analgesia
 - Inadequate
 - Overdose
- Infection



Failure to **actively monitor** for these may be fatal



In a Pulmonary Hypertensive Crisis

- Administer 100% oxygen
- Hyperventilate
- Correct metabolic acidosis
- Attenuate noxious stimuli
- Support cardiac output
 - Pre-load (↓ing viscosity also)
 - Inotropes
- Administer pulmonary vasodilators



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Summary

- Congenital heart disease patients survive to adulthood & require the services of general anaesthetists
- Maintain the patient's own 'normal' saturation wherever possible – it is best physiological compromise for them
- Pulmonary hypertension is a high risk when undertaking interventional procedures – actively manage it