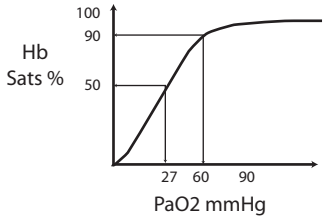
JULY 2007
QUESTION 11

# Describe the acid base changes that occur in acute hypoxaemia

Hypoxaemia is defined as a PO2 in arterial blood below normal physiological levels.

Different textbooks use different values although a value of less than 60mmHg is useful as this represents the beginning of the steep part of the Hb-O2 curve and corresponds to a saturation of approximately 90%.

Hb-O2
Dissociation Curve




Physiological causes of acute hypoxaemia are

| | |
|---|---|
| Decreased alveolar oxyen | PAO2 = FiO2(Patm - 47) - PCO2/0.8 |
| Decreased ventilation | Vent = RR(tidal volume - dead space) |
| Shunt | V/Q = 0 |
| V/Q mismatch | V/Q > 0 but not 1 |
| Diffusion limitation | Ficks law |
| Consumption of O2 | Increased extraction ratio 100(1 - MV O2 cont/Art O2 Cont) |

Acid base changes

- initially - respiratory compensation
- later - at cellular level

When PaO2 drops below 60mmHg

- Peripheral chemoceptors in the carotid bodies and aortic arch sense decreased paO2
- Central respiratory centre in the medulla rapidly increases ventilation (within 10 mins)
- As a result there may be an improvement in paO2 (cause dependent)
- pCO2 decreases due to increased ventilation leading to respiratory alkalosis (pH > 7.45)

At a tissue mitochondrial level

- When the partial pressure reaching the mitochondria drops below 5mmHg
- Oxidative phosphorylation is impaired
- Anaerobic pathways of energy production utilised producing lactate and hydrogen ions
- Cause an increased anion gap metabolic acidosis due to lactate (pH < 7.35)

Ventilation increase augmented to compensate for the metabolic acidosis and CO2 drops further

HCO3 is levels drop as it buffers the acidosis, renal compensation to retain more HCO3

Increased hydrogen ion levels shift the HbO2 curve right enabling improved O2 delivery at the tissues

Eventually the brain becomes hypoxaemic and respiratory drive is depressed, thereby removing respiratory compensation and resulting in increasing acidosis, failure of the Na.K.ATPase pumps in most cells, cell lysis and death.