Respiratory Complications

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Apnoea

Apnoea is the cessation of breathing, either transient in form or longer. Untreated apnoea rapidly leads to hypoxia, resulting in severe respiratory acidosis and cardiac arrest.

Causes

Induction agents, inhalational agents, potent opioids, hyperventilation and hypocapnia, elevated intracranial pressure (ICP), and equipment errors.

Treatments

Note: Your patient must be intubated, if not: Intubate!

- **Post induction:** Intermittent positive pressure ventilation (IPPV) at 4-6 breaths/minute
- **Too deep on inhalational agent or total intravenous anaesthetic (TIVA):** Lighten the patient and provide IPPV
- **Fentanyl bolus:** IPPV at 4-6 breaths/minute
- **$ETCO_2$ too low:** IPPV 4 breaths/minute (or less with the aid of capnography)
- **Suspect elevated ICP:** IPPV to decrease $ETCO_2$ to ~ 30-35mmHg, head elevation by 30°, mannitol
- **Closed APL valve:** Immediately open, full check of patient: Are they alive? Do they have a pneumothorax?
- **Cardiopulmonary arrest:** Immediately initiate CPR (turn off anaesthetic, flush the anaesthetic circuit and remain on oxygen). 1 breath every 6 seconds, 100 – 120 compressions/minute

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Hypoxaemia

Hypoxaemia is low blood oxygen content, while hypoxia is low tissue oxygenation. It can be defined as a partial pressure of oxygen in arterial blood of <80 mmHg, or an arterial blood haemoglobin saturation (SpO_2) of less than 95%.

Causes

There are five main causes of hypoxaemia: Low inspired oxygen (low FiO_2), diffusion impairment, right to left shunt, ventilation to perfusion (V/Q) mismatch, and hypoventilation.

Treatments

- **Low FiO_2:** Increase oxygen percentage where possible, check oxygen is still flowing, and that the circuit is still connected to the endotracheal tube.
- **Nitrous oxide use:** Check ratios with oxygen (remember nitrous oxide to oxygen flow rate is 2:1) and check correct flowmeter in use (nitrous oxide can not be delivered without oxygen)
- **Hypoventilation:** Increase respiratory rate and increase FiO_2 if possible
- Increase peak airway pressure (alveoli expanded for longer)
- Increase inspiratory time (longer inspiration time)
- Use positive end expiratory pressure (PEEP)

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Hypercapnia

Excessive carbon dioxide in the blood. The partial pressure of carbon dioxide in arterial blood's ($PaCO_2$) normal range is 35 – 45 mmHg. Hypercapnia can be defined as mild, moderate or severe.

Causes

Rebreathing, hypoventilation, increased dead space, and increased CO_2 production

Treatments

- **Rebreathing:** Increase fresh gas flowrate on non-rebreathing circuits, change soda lime regularly and dry one-way valves (and ensure they are replaced carefully)
- **Hypoventilation:** IPPV (manually or via a small animal ventilator). Decrease anaesthetic depth if possible, and if patient is on a ventilator, check ventilator settings are adequate to keep normocapnia.
- **Increased dead space:** Remove extra adaptors, and cut endotracheal tubes to appropriate lengths for the species and patient size (remember from the incisors to the thoracic inlet)
- **Increased CO_2 production:** Monitor core body temperature throughout anaesthesia period and into recovery. Provide IPPV (either manually or via a small animal ventilator), and use active cooling methods.