General Anaesthesia
Normothermia

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Enhanced Recovery after Surgery

* Outline
  * ERAS & General Anaesthesia
    * Anaesthesia
    * Analgesia
    * Muscle relaxation
  * Normothermia
    * Definitions
    * Hypothermia - Risk Factors and Consequences
    * Active and Passive Measures
ERAS and General Anaesthesia

- Traditional Triad
  - Anaesthesia
    - Induction and Maintenance
  - Analgesia
    - Covered by Dr Lemech
  - Muscle Relaxation
    - Muscle Relaxants
    - Reversal

- Aims
  - Short acting agents allow rapid wake up
  - Control Metabolic Stress
    - Fluids
    - Analgesia
    - Reduce haemodynamic fluctuation
* **Induction Agents**
  * Propofol – recommended by ERAS as short acting
  * Thiopentone – Becoming dated / Rapid Sequence?
  * Short acting Opioids – Fentanyl / Remifentanil infusion

* **Maintenance**
  * Volatiles – Sevoflurane / Desflurane (obese)
  * TIVA – with propofol if Hx of PONV
  * No Mention of N₂O
**Muscle Relaxation**

* **Benefits**
  * Deep blockade enables good surgical access

* **Agents**
  * Amino Steroids – Rocuronium / Vecuronium
  * Benzylisoquinolininiums – Atracuriom / Cisatracurium

* **Pit falls**
  * Anaphylaxis risk – Pholcodine use and Rocuronium
  * UK NAP5 – Accidental Awareness Under General Anaesthesia
    * Miss match of Anaesthesia and paralysis
    * Unholy TRIAD
      * Relaxants / No reversal / No Monitoring
Muscle Relaxation

* Peripheral Nerve Stimulator
  * Train of Four
    * Deep No twitches / Post tetanic count
    * 1 to 4 twitches – reversible
    * Fade – adequate reversal of $4^{th} > 70\%$ of First

* Reversal
  * Traditional – Neostigmine / AntiCholinergic
  * Novel – Sugammadex – Rocuronium
    * Immediate – 16mg/Kg
    * End of case – 2-4mg/Kg
Monitoring

- Standard Anaesthesia Monitoring
  - BP / ECG / Pulse Oximeter
- Haemodynamic Monitoring
  - Oesophageal Doppler?
- Depth of Anaesthesia Monitoring
  - Entropy / BIS
  - Optimise depth of anaesthesia
    - Prevent Awareness in paralysed patients?
    - Too deep – Post op confusion and harm?
Normothermia – Avoiding hypothermia

* Definitions
  * Heat
    * Thermal energy in the body
  * Temperature
    * Average thermal energy per unit mass
  * Normal temperature – 36.5 – 37.5°C
  * Hypothermia – Core Temperature <36°C
Heat Distribution

- Core Compartment
  - 66% Body Mass
  - Central Organs
  - Tightly controlled
- Peripheral Compartment
  - 34% Body Mass
  - Heat sink
  - Varies 28-36°C
Anaesthesia and Temperature

- Redistribution
- Vasodilation
- Linear Phase
  - Radiation 40%
  - Convection 30%
  - Conduction 5%
  - Evaporation 15%
  - Respiratory 10%
- Plateau
  - Vasoconstriction
Hypothermia – Clinical Consequences

- **Bleeding**
  - Clotting factors are enzymes
- **Morbidity**
  - Myocardial / Cerebral Ischaemia
  - Cardiac Arrhythmias
- **Decreased drug metabolism**
- **Infection**
- **Shivering**
- **Pain Scores** – worse if hypothermic
Avoiding Hypothermia

* Prevention is better than cure
* UK NICE 2008 Guidelines – At risk if 2 of
  * ASA II-V
  * Pre-operative Temperature <36°C
  * Combined General and Regional Anaesthesia
  * Major / Intermediate Surgery
  * Cardiovascular complication risk
Avoiding Hypothermia

**Active Measures**
- Deliver Heat to Patients
  - Forced Air Warming Blankets
  - Warming Mattresses

**Passive Measures**
- Reduce Heat lost
  - Blankets / reflective foil
  - Warm fluids – Crystalloids / Blood
  - Humidified Gasses
    - Respiration / Laparoscopy
Active Warming

* Pre-Warming
  * Max temp setting
  * Approx 1hr
  * Raise periphery to core temperature

* Intra-Op
  * Aim to maintain @ 36.5°C

* Post-Op
  * Continue if hypothermic until normothermia achieved
Summary

* Optimise pre-operative temperature
* Avoid excessive exposure
* Ensure fluids and gasses are warmed

* Maintenance of normothermia may reduce
  * Bleeding / Infection / Cardiac complications