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# Great Ormond Street Hospital for Children



NHS Trust

## Anaesthesia in Infants and Children

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**Associated clinical guidelines/protocols:**

- Guideline Sedation module and rough guide
- Management of a difficult airway guideline
- Procedures on PICU
- Train of Four guideline

**Fundamental Knowledge:**

*List of topics relevant to PIC that will have been covered in membership examinations. They will not be repeated here.*

## Information for Year 1 ITU Training (basic):

**Year 1 ITU curriculum****Pre-operative Assessment of Risk:**

- Factors determining perioperative risk
- Importance of preoperative health status on postoperative outcomes & methods of optimising high risk surgical patients

**Peri and Post-operative considerations:**

- **Airway management & Intubation covered in "Airway Management" module**
- **Sedative, analgesic and neuromuscular blocking agents covered in "analgesia, sedation and neuromuscular blockade" module**
- Common inhalational anaesthetic agents, side effects
- *Causes of failure to waken from anaesthesia:* residual anaesthetic agents, hypothermia, hypoxic-ischaemic encephalopathy, spinal cord injury (Downs syndrome)
- *Causes of Post operative respiratory insufficiency:* CNS depression, airway obstruction, residual neuromuscular blockade, abdominal splinting, phrenic nerve damage, parenchymal disease (aspiration), post thoracotomy
- *Causes of Post operative cardiovascular insufficiency:*
- Shivering, nausea and vomiting
- Peri-operative prophylactic anti-thrombotic therapy

**The suggested basics are covered in any good speciality textbook:**

Manual of Pediatric Anesthesia. **Steward and Lerman**

**Pre-operative Assessment of Risk:**

- Factors determining perioperative risk
  - Congenital anomalies, acquired disease e.g. ALL, elective vs emergency, surgery, clotting disorders – the list is long

- Importance of preoperative health status on postoperative outcomes & methods of optimising high risk surgical patients
  - See above! Nutritional status –neonates and wound healing. Steroid etc

### Peri and Post- operative considerations

- Common inhalational anaesthetic agents, side effects
  - Inhalation Anaesthetics are delivered by anaesthetists on the ICU, either trained intensivists or anaesthetic staff.
  - Most inhalation induction on PICU is for airway issues: Halothane, with a low potential for irritation of the upper airway, is commonly used in paediatric patients with compromised airways. Some of the newer inhalation anaesthetic agents including isoflurane, enflurane and more recently desflurane, are particularly **irritant** to the upper airway causing coughing and laryngeal spasm. This limits their value for inhalational induction in children with compromised airways. In contrast, sevoflurane does not irritate the upper airway
  - The induction characteristics of sevoflurane in children is comparable with halothane, and induction time is less: **sevoflurane may be the preferred agent in children.**
- **Causes of failure to waken from anaesthesia:** residual anaesthetic agents, hypothermia, hypoxic-ischaemic encephalopathy, spinal cord injury (Downs syndrome)

#### Residual drug effects

- opiates
- ongoing effects of volatiles

Pain (or lack of!)

Consider other causes -

CNS pathology – ischaemia, haemorrhage, infarction (?Ass intra-op hypotension/hypertension/hypoxia), seizures

Spinal cord injury: commoner in Downs syndrome

Hypoglycaemia/hyperglycaemia

Hypercapnia, hypothermia, hyponatraemia,

Certain surgical procedures ie cardiopulmonary bypass

Slow to wake if fail to progress beyond protective airway reflexes and minimal conscious awareness

Awake if : orientated in time/place/person, and respond meaningfully in conversation

Need to evaluate quickly if neurosurgical eg- craniotomy

- **Causes of Post operative respiratory insufficiency:** CNS depression, airway obstruction, residual neuromuscular blockade, abdominal splinting, phrenic nerve damage, parenchymal disease (aspiration), post thoracotomy

#### Hypoventilation

Common

Increase in PaCO<sub>2</sub>, decreased PaO<sub>2</sub>

Causes:

- . Respiratory drive
- . airway obstruction
- . Other issues

#### 1) Respiratory Drive

Opioids, volatile agents or other respiratory depressant drugs

Hypothermia

CNS pathology – pre and intra op eg spinal compromise

#### 2) Airway obstruction

Tongue

Secretions

Foreign body

Laryngeal oedema  
Laryngospasm or bronchospasm

**3) Other problems**

Pain eg post thoracotomy  
Abdominal distension  
Pneumothorax  
Aspiration  
Muscle weakness  
    Residual neuromuscular blockade  
    Electrolyte disturbances  
Phrenic nerve –transection/neuropraxis etc

- **Causes of Post operative cardiovascular insufficiency:**

- Too many to list, majority linked to pre-anaesthetic state i.e. diagnosis and operation performed
- Shivering, nausea and vomiting

Shivering

Spontaneous asynchronous random of skeletal muscles contraction in effort to increase BMR  
Common (up to 70% post GA in adults? in children)

- . Hypothermia
- . Post epidurals ?anaesthetic effect
- . Not related to core body temp:
  - Commoner in boys
  - Linked to menstrual cycle in girls
  - Anticholinergic meds
  - Thiopentone use

Nausea and vomiting

GA effect, but NB post GI surgery

- Peri-operative prophylactic anti-thrombotic therapy
  - Not routine in children
    - If specific risk e.g. previous thrombosis, clotting disorder
      - Will be specific advice from haematologist
  - Prolonged immobility on PICU –TED stockings +/- LMW heparin
    - Age>12, weight > 60 kg –no data, consultant choice

## Information for Year 2 ITU Training (advanced):

### Year 2 ITU curriculum

- Causes, recognition and management of Malignant Hyperthermia
- Suxamethonium apnoea

Additional Peri and Post- operative considerations:

- Effect of congenital heart disease: R-to-L shunts (effect of BP alterations), L-to-R shunts (effect of 100% O<sub>2</sub>, effect of BP alterations) & obstructive lesions
- Effect of myocardial dysfunction: volume status, effects of anaesthetic agents on function, rate, SVR, rhythm
- Risk associated with patients with neuropathies and myopathies
- Risks associated with electrolyte disorders

### Curriculum Notes for Year 2:

**Malignant hyperthermia** -genetic disorder of skeletal muscle metabolism

-most commonly associated with inhalational anaesthetics (halothane, isoflurane) when given with suxamethonium, although can occur with suxamethonium alone.

- 50% of all cases children < 15

-children with Hx muscle disorders eg muscular dystrophy greatest risk

Diagnosis based on triad muscle rigidity, hyperthermia, and metabolic acidosis

-not always present, especially if diagnosis and treatment early

Early signs: tachycardia, tachypnea, muscle rigidity, ventricular dysrhythmias, and hypercarbia.

Late signs: hyperthermia, sweating, skin mottling, mydriasis, myoglobinuria, mixed metabolic and respiratory acidosis, elevated CK, and hyperkalemia

Muscle rigidity first noticed in masseter muscles.

Treatment –stop causative agent, hyperventilate 100% O<sub>2</sub>. Dantrolene is drug of choice and should be given ASAP (blocks calcium release from sarcoplasmic reticulum) Recommended dose is 2.5 mg/kg, repeat every 5 minutes if signs of hypermetabolism persist

Reversal of clinical signs should occur rapidly, if diagnosis correct!

### Suxamethonium apnoea

Rare. Inherited, or spontaneous (i.e no family history).

**Inherited** plasma cholinesterase level reduced,

Several variations of normal enzyme E1<sup>U</sup>, most common E1<sup>A</sup>. - carried 4% Caucasian population, higher in Asians/Middle East and lower in Africans

If heterozygous(E1<sup>U</sup>E1<sup>A</sup>) increased recovery time from suxamethonium (30 mins).

If homozygous (E1<sup>A</sup>E1<sup>A</sup>) can take  $\geq 2$  hours to recover from suxamethonium.

Rarer genes exist

**Acquired** plasma cholinesterase is normal but activity is reduced.

Can occur in the following situations;

- Pregnancy
- Hypothyroidism
- Liver disease
- Renal disease
- Carcinomatosis
- Cardiopulmonary bypass
- Anticholinesterases
- Monoamine oxidase inhibitors
- Methotrexate

Action of suxamethonium is lengthened by minutes rather than hours

Additional Peri and Post- operative considerations:

- Effect of congenital heart disease: R-to-L shunts (effect of BP alterations), L-to-R shunts (effect of 100% O<sub>2</sub>, effect of BP alterations) & obstructive lesions
  - This is basically the entire field of congenital heart disease. CHD anaesthesia is an extremely specialized area. The effect of most anaesthetic drugs on the various CHD physiological states are NOT well described.
  - PVR/SVR manipulation, and drugs in cardiomyopathy and obstructive states is covered in CHD modules
- Effect of myocardial dysfunction: volume status, effects of anaesthetic agents on function, rate, SVR, rhythm
  - Again this is a massive field and covers the physiology of anaesthetic pharmacology-see textbooks discusses above
- Risk associated with patients with neuropathies and myopathies
- Risks associated with electrolyte disorders

**Other sources of information:**

**Websites.**

**References.**

**Stevens RD Neuromuscular disorders and anesthesia. Curr Opin Anaesthesiol. 2001 Dec; 14(6): 693-8**