PAEDIATRICS FOR THE FINAL FRCA

Dr Bev Parker ST7 Leeds Teaching Hospitals
Aims

- Exam Oriented
- Interactive
- Past paper questions
- Common Paediatric Anaesthesia themes
- General advice for FRCA preparation
- NICE guidelines
- AAGBI core topics
- Syllabus
- CEACCP articles
Final FRCA Past Exam Questions
15kg 2 yr old boy under GA for small umbilical hernia. LMA spont breathing. Otherwise F+W. 30 min into procedure sudden brady to 30bpm and ETCo2 -0.

Which is the correct answer

A) 4.0 ETT, 300 mcg adrenaline, defib 30 J
B) 4.5 ETT, 150mcg adrenaline, defib set to 60 J
C) 4.0 ETT, 150mcg adrenaline, defib 60J
D) 4.5 ETT 150mcg adrenaline, defib set to 30 J
E) 4.0 ETT 300mcg adrenaline, defib set to 60J
Paediatric Life Support

Consider front and back defib pads in infants <8 years use paediatric pads (AED)
>8 use adult pads (AED)

**W**

- Estimated Weight = (age x2) + 4
- Weight = (age + 4)² (old formula)

**E**

- Energy = 4J/kg

**T**

- Tube Diameter = (Age/4) + 4
- Oral Tube Length = (Age/2) + 12
- Nasal Tube Length = (Age/2) + 15

**F**

- IV Fluid - 20mls/kg for medical emergencies
- 10ml/kg for trauma

**L**

- Lorazepam 0.1mg/kg

**A**

- Adrenaline IV
  - 0.1ml/kg of 1:10 000

- Dextrose 10% 2ml/kg

- Amiodarone 5mg/kg after 3rd shock
- Repeat after 5th shock (if shockable)

- Atropine 20mcg/kg
- Cefuroxime 80mg/kg
- Diazepam 0.5mg/kg
- Ibuprofen 5mg/kg
- Paracetamol 20ml/kg
- Paracetamol 5ml/kg

**Diagram**

- CPR (5 initial breaths then 15:2)
- Attach defibrillator/monitor
- Minimise interruptions
- Compressions: 100 - 120 bpm

- APLS 4th edition estimates on a continuum of an average weight of 3.5kg at birth to 10kg at 12 months

- New formula:
  - Weight 0 - 1 = (Age/2) + 4
  - Weight 1 - 5 = (Age x2) + 8
  - Weight 6 - 12 = (Age x3) + 7

**Resuscitation Council (UK)**

2010 Resuscitation Guidelines
A 5-year-old patient presents for a myringotomy and grommet insertion as a day case. During your pre-operative assessment you notice that the patient has a nasal discharge.

a) Why would it be inappropriate to cancel the operation on the basis of this information alone? (25%)

b) List the features in the history (35%) & examination (25%) that might cause you to postpone the operation due to an increased risk of airway complications in this patient.

c) What social factors would preclude this child’s treatment as a day case? (15%)
CEACCP 2011 Dilemmas in the preoperative assessment of children

- The ‘average’ child has up to seven episodes of URTI per year.
- Most viral aetiology, but the prodromal phase of severe systemic illness can have similar symptoms.
- It is estimated that a quarter of children have a runny nose for a large proportion of the year due to other causes, such as hypertrophic adenoids or allergic rhinitis.
- URTI may produce airway hyper-reactivity persisting for several weeks, resulting in laryngospasm, bronchospasm, breath holding, and desaturation.

**Schedule/cancel the surgery?**

- Although the traditional approach of blanket cancellation of surgery avoids the potential for complications, it imposes emotional and economic burdens for the parents.
- Schreiner and colleagues estimated that 2000 surgical procedures in children with mild URTI would need to be cancelled to prevent 15 episodes of laryngospasm.
- Hyper-reactivity of the airway may persist up to 4 weeks, resulting in increased risk of respiratory complications, hence the rationale to defer surgery for 4–6 weeks in severe URTI.
- **O/E** exclude crackles, wheeze, and bronchial breathing, and inspection of the nostrils for purulent discharge. Visualization of the oropharynx may confirm large, inflamed tonsils but relies on the cooperation of the child.
- X-ray changes or leucocytosis may corroborate a clinical diagnosis but add very little to the process of decision-making as both may be normal, despite a clinically significant URTI.
- A fever above 38°C is significant.
Suggested algorithm for the assessment and anaesthetic management of the child with URTI.

Hx, history; TT, tracheal tube; LMA, laryngeal mask airway.

Nandlal Bhatia, and Nicola Barber
Contin Educ Anaesth Crit Care Pain 2011;bjaceaccp.mkr039

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September 2013 - Airway

- a) List the normal anatomical features of young children (< 3 years old) which may adversely affect upper airway management. (35%)
- b) Which airway problems may occur due to these anatomical features? (30%)
- c) Outline how these problems are overcome in clinical practice. (35%)
Paediatric Airway

- Large head
- Short neck
- Prominent occiput
- Large tongue (relative to mandibular space)
- No teeth
- High anterior larynx (C2-3) (C4-5 in adults)
- High epiglottis so that the infant can breathe and swallow at the same time
- Long U-shaped epiglottis (flops posteriorly, so keep head in neutral position)
- Obligate nasal breathers
- Airway narrowest at level of cricoid cartilage (vocal cords in adults)
- Trauma easily causes oedema (pseudostratified ciliated epithelium only loosely bound to underlying areolar tissue)
- Because Resistance is 1/radius, small amount of oedema increases resistance a lot
- Trachea 4-5cm long and funnel shaped
- Angle of mandible 1400 (1200 in adults)
- More reactive (i.e. more likely to develop laryngospasm)
And again May 2007...

- a) List the normal anatomical features of young children (< 3 years old) which may adversely affect airway management. (25%)
- b) What airway problems may occur due to these anatomical features? (30%) c) Describe how these problems are overcome in clinical practice. (35%)
March 2013 – Cerebral Palsy

- An 8-year-old child with severe cerebral palsy is scheduled for an elective femoral osteotomy.
- a) Define cerebral palsy? (15%)
- b) List the clinical effects of cerebral palsy on the central nervous, gastro-intestinal, respiratory and musculoskeletal systems with their associated anaesthetic implications. (50%)
- c) What are the specific issues in managing postoperative pain in this patient? (35%)
CEACCP 12 April 2010 – Cerebral palsy and Anaesthesia

A) Definition of CP:

Collective term used to describe a diverse group of neurological disorders characterized by varying degrees of motor, sensory, and intellectual impairment.

B) CNS epilepsy, expressive language disorders problems affecting speech. Communication difficulties may heighten a patient's perioperative anxiety? anxiolytic premed

Respiratory if premature will have underlying chronic lung disease. Increased risk of aspiration pneumonitis and consequently chronic lung scarring because of swallowing difficulties, oesophageal dysmotility, abnormal lower oesophageal sphincter tone, and spinal deformity. Weak cough, respiratory muscle hypotonia – recurrent chest infections.

Long-term truncal spasticity can lead to scoliosis, restrictive lung defects, pulmonary hypertension, cor pulmonale and respiratory failure.

GI malnutrition (decreased immunity) dehydration, anaemia, and electrolyte imbalances. GORD

MSK difficulties with patient positioning and vascular access.

Significant side-effects and drug interactions related to polypharmacy may have implications for anaesthesia.
**Anaesthetic implications**

- Succinylcholine is not contraindicated in patients with CP. Although some studies have demonstrated the presence of extra-junctional ACh receptors in up to 30% of CP patients, other studies have demonstrated no significant difference in potassium release after succinylcholine administration to children with CP when compared with non-affected children.

- NDMRs are less potent and have a shorter duration of action in patients with CP owing to the up-regulation of ACh receptors. Clinically, this is offset by the fact that these highly water-soluble drugs are redistributed through a smaller volume of total body water because these patients are often relatively dehydrated compared with other groups of patients.

- secure the airway with a tracheal tube plus modified RSI

- no evidence to suggest that RSI is any safer than a gas induction with the patient inclined at 20–30° head-up tilt. A gas induction is often the only option in the ‘veinless’ uncooperative patient.
C) Post op pain

- Communication difficulties can make the assessment of postoperative pain difficult.
- Postoperative analgesia should be based on ‘continuous’ rather than ‘on demand’
  regimens.
- Acetaminophen and non-steroidal anti-inflammatory drugs should be given regularly and supplemented with i.v. morphine infusions or local anaesthetic-based epidural infusions or other regional blocks as appropriate.
- Systemically and extradurally administered opioids should be used with caution in CP
  patients because they can accumulate resulting in over-sedation, suppress of the cough reflex, and depression of respiration in this already vulnerable patient group.
- Hypothermia, postoperative pain, and anxiety can all trigger acute muscle spasms
  which are often more painful and distressing to the patient than the operation itself.
- Caudal or epidural analgesic techniques combining extradural clonidine with a local anaesthetic agent are proving to be beneficial in combating pain associated with both the operative procedure and muscle spasms.
A 4 year-old child is admitted to the Emergency Department with suspected meningococcal septicaemia. You are asked to help resuscitate the patient prior to transfer to a tertiary centre.

a) List the clinical features of meningococcal septicaemia. (35%)
b) Outline the initial management of this patient. (45%)
c) Which investigations will guide care? (20%)
NICE guidelines

## Common non-specific symptoms / signs (not always present, especially in neonates)

<table>
<thead>
<tr>
<th>Symptom / sign</th>
<th>Bacterial meningitis (meningococcal meningitis and meningitis caused by other bacteria)</th>
<th>Meningococcal disease (meningococcal meningitis and/or meningococcal septicæmia)</th>
<th>Meningococcal septicæmia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Vomiting / nausea</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Lethargy</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Irritable / unsettled</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Ill appearance</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Refusing food / drink</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Headache</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Muscle ache / joint pain</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Respiratory symptoms / signs or breathing difficulty</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

## More specific symptoms / signs

<table>
<thead>
<tr>
<th>Symptom / sign</th>
<th>Bacterial meningitis (meningococcal meningitis and meningitis caused by other bacteria)</th>
<th>Meningococcal disease (meningococcal meningitis and/or meningococcal septicæmia)</th>
<th>Meningococcal septicæmia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-blanching rash&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Stiff neck</td>
<td>Y</td>
<td>Y</td>
<td>Not known</td>
</tr>
<tr>
<td>Altered mental state&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Capillary refill time more than 2 seconds</td>
<td>Not known</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Unusual skin colour</td>
<td>Not known</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Shock</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Hypotension</td>
<td>Not known</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Leg pain</td>
<td>Not known</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Cold hands / feet</td>
<td>Not known</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Back rigidity</td>
<td>Y</td>
<td>Y</td>
<td>Not known</td>
</tr>
<tr>
<td>Bulging fontanelle&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Y</td>
<td>Y</td>
<td>Not known</td>
</tr>
<tr>
<td>Photophobia</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Kernig's sign</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Brudzinski's sign</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Unconsciousness</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Toxic / moribund state</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Initial management

- ABC
- If SV 15-litre face mask oxygen via a reservoir rebreathing mask.
- Airway manoeuvres
- Intubation by senior anaesthetist (CALL FOR HELP)
- Aware that gravely ill, risk of sudden deterioration following intubation.
- Following are available before intubation:
  - Facilities to administer fluid boluses
  - Appropriate vasoactive drugs
  - Access to experienced help
- Antibiotics, steroids, IV fluids
- Transfer – Embrace, parental communication
Investigations - classify

- Bedside tests: Bloods, Venous gas, LP
- metabolic disturbances
  - hypoglycaemia
  - acidosis
  - hypokalaemia
  - hypocalcaemia
  - hypomagnesaemia
  - anaemia
  - coagulopathy.
A 9 year-old child with Down’s syndrome is scheduled for an adenotonsillectomy.

a) List the airway/respiratory (30%), cardiovascular (10%) and neurological (10%) features of the syndrome relevant to the anaesthetist.

b) What are the general principles involved in the preoperative (15%), intraoperative (25%) and postoperative (10%) management of this patient with Down’s syndrome?
Airway Considerations with Down’s Syndrome

- Macroglossia
- Possible subglottic stenosis (so may use an ETT 0.5-1.0 size smaller)
- Atlanto-axial stability in 15% of patients (so avoid excessive neck movement on laryngoscopy)
- OSA common
- GORD
Cardiovascular

- 16-60% have a cardiac abnormality
- Endocardial cushion defects (AVSDs, ASDs, VSDs)
- PDA
- Tetralogy

Neurological

- Developmental delay
- Epilepsy 10%
- Early onset Alzheimers
Preop

- History (Cyanotic episodes), examination – heart failure, careful assessment of airway notes, previous anaesthetic chart, Symptomatic – C spine Xray.
- Antacid

Intra-op

- Preparation for
  - Difficulties with co-operation at induction – previous premed? Mention light premed, risk of hypoxia with CVS disease.
  - Calm environment
  - Airway difficulties – smaller ETT
  - Careful airway manipulation
  - IV access may be difficult - US available
  - Senior help (as all the above)
- Strict asepsis for all procedures due to relative cellular immunodeficiency putting the child at a greater risk of infection.
- Increased vigilance for aspiration due to the increased incidence of GORD
- Attempt to optimise cardiorespiratory function due to possibility of underlying pathology
- Specialist centre
- Minimal/avoid opiates – multimodal analgesia

Post-op

- Overnight stay (OSA) HDU
- Increased risk of post extubation stridor, post op chest infections and pulmonary oedema (prone to hypotonia)
- Supplemental humidified o2 and physiotherapy should be implemented early if needed.
- Multimodal analgesia – avoid opiates
You are asked to assess a 4 year-old child who is scheduled for a strabismus (squint) correction as a day case procedure.

a) List the anaesthetic related issues this case presents. (60%)

b) During surgical traction, the patient suddenly develops profound sinus bradycardia. How would you manage this situation? (10%)

c) Describe the key postoperative problems and relevant management strategies. (30%)
Patient factors

- Most ASA Class I or 2 (day cases).
- Or the eye problem may be part of a chromosomal or metabolic disorder.
- A number of conditions associated with difficult intubation are associated with squints. CP, Down's syndrome, hydrocephalus and space-occupying lesions are more likely to develop strabismus.
- Although very rare, an increased incidence of malignant hyperpyrexia has been reported in patients with a squint, and a high index of suspicion should be maintained for this.

Surgical Factors

- High incidence of PONV with this procedure.
- Oculocardiac reflex, a bradycardic response to extraocular muscle traction.
- It has been postulated that these two events might be associated.
- Blocking the afferent limb of the reflex using a peribulbar block is one way of achieving this, but this carries a risk of perforating the globe and is inadvisable in children.
- Administer atropine 20 µg kg⁻¹ at induction and to accept the resultant modest tachycardia.
- Hypercarbia has been shown to double the incidence of significant bradycardia.
<table>
<thead>
<tr>
<th>Increase IOP</th>
<th>Decrease IOP</th>
<th>Minor/No effect on IOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suxamethonium</td>
<td>Propofol, Thiopentone</td>
<td>Ketamine</td>
</tr>
<tr>
<td>Hypoxia</td>
<td>Halothane, Sevoflurane, Isoflurane, Desflurane</td>
<td>Opioids</td>
</tr>
<tr>
<td>Hypercapnia</td>
<td>Acetazolamide, mannitol</td>
<td>Atropine</td>
</tr>
<tr>
<td>Laryngoscopy, coughing, straining, crying</td>
<td>Hypothermia</td>
<td>NDMR</td>
</tr>
<tr>
<td>Increased venous pressure</td>
<td>Hypocapnia</td>
<td></td>
</tr>
<tr>
<td>External pressure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A two year-old child presents to the Emergency Department (ED) with sudden onset of fever (38.5 °C aural), sore throat, drooling and stridor.

a) What conditions should be considered in the differential diagnosis? (20%)

b) What would be your initial management of this child in the ED? (25%)

c) How would you subsequently manage a deteriorating child? (45%)
Differential diagnosis

Congenital
- Laryngomalacia
  (or pharyngo/trachea/bronchomalacia)
- Vocal cord dysfunction
- Laryngeal stenosis (subglottic stenosis)
- Laryngeal papillomatosis
- Vascular ring
- Tumour eg haemanigioma

Acquired
- Croup (laryngotracheobronchitis) 80%
- Inhaled FB
- Tracheitis
- Abscess
- Anaphylaxis
- Epiglottitis rare since Hib
SBA – regarding acute stridor in children which **one** is correct

- A) RSV most commonly causes laryngotracheobronchitis
- B) Because of the potential for complete airway obstruction, a IV cannula should be inserted as a priority
- C) Steroids no longer have a place in the treatment of croup
- D) Once intubated – patients with croup tend to have a longer time to extubation than those with epiglottitis
- E) A 2 day history of high fever and barking cough in a 4 yr old is a typical history of croup.
Answer

- D

- The commonest cause of croup is parainfluenza virus
- RSV can cause croup but more likely to cause bronchiolitis
- Rx of croup O2, steroids and nebulised adrenaline
- If croup is severe enough to need intubation extubation may take up to 10 days.

- 4 yrs a little old for croup, rapid onset and high grade fever more likely epiglottitis.
Initial management

- Stridor is a harsh, vibratory sound produced when the airway becomes partially obstructed, resulting in turbulent flow. It is symptomatic of underlying pathology and may herald life-threatening airway obstruction.
- Disturbed as little as possible
  - Crying and agitation increase respiratory effort and might precipitate complete airway obstruction.
  - Adopt the posture in which they are most comfortable
  - Parents should be present.
  - Examination of the throat and i.v. cannulation should not be attempted.
Management cont.

- Examination may be limited to inspection for signs of increased work of breathing
- Pulse oximeter probe is usually well tolerated
- Gentle examination of the chest may be possible.
- Children with symptoms and signs of severe airway obstruction require urgent examination of the airway under anaesthesia to determine the cause and secure the airway.
- Experienced ENT surgeon present
- Experienced Anaesthetist present
- ETT size sometimes very small.
- Gas induction in theatre (if transfer possible)
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Infant</td>
<td>&gt;50 bpm</td>
</tr>
<tr>
<td>Child</td>
<td>&gt;30 bpm</td>
</tr>
<tr>
<td>Effort</td>
<td></td>
</tr>
<tr>
<td>Infant</td>
<td>Head bobbing; nasal flaring</td>
</tr>
<tr>
<td>Child</td>
<td>‘See-saw’ chest and abdomen; recession: substernal, sternal, intercostal,</td>
</tr>
<tr>
<td></td>
<td>tracheal tug; nasal flaring</td>
</tr>
<tr>
<td>Posture</td>
<td></td>
</tr>
<tr>
<td>Infant</td>
<td>Arching backwards</td>
</tr>
<tr>
<td>Child</td>
<td>Tripod position</td>
</tr>
<tr>
<td>Noise</td>
<td>Infants grunt to generate auto-CPAP; wheezing can occur with an inhaled</td>
</tr>
<tr>
<td></td>
<td>foreign body; stridor</td>
</tr>
<tr>
<td>Ineffective breathing</td>
<td>Hypoxaemia and hypercarbia produce tachycardia, sweating, restlessness</td>
</tr>
<tr>
<td></td>
<td>and confusion, agitation and anxiety, pallor, or mottling</td>
</tr>
<tr>
<td>Impending respiratory</td>
<td>Decreased conscious level, slowing ventilatory frequency, episodes of</td>
</tr>
<tr>
<td>arrest</td>
<td>apnoea, silent chest despite vigorous respiratory effort, bradycardia</td>
</tr>
</tbody>
</table>
- The phase of stridor may indicate the level at which the airway is compromised.
- The volume of stridor does not correlate with the degree of obstruction.
- For example, a progressive decrease in volume may signify a decreasing conscious level.
Again in October 2007.....

- You are asked to see a 2 year-old boy in the Emergency Department who has stridor and a barking cough. He is febrile and is sitting upright with suprasternal and substernal recessions.
- a) What is stridor and what does it indicate? (15%)
- b) List the possible causes of stridor in a child of this age, indicating which is the most likely in this case. (35%)
- c) Outline your initial management of this child in the Emergency Department. (40%)
You are asked to review a 5 year-old child who has undergone a tonsillectomy earlier that day. The child needs to return to theatre for control of bleeding.

a) What are the important considerations in the assessment of this child? (40%)

b) Compare the advantages and disadvantages of intravenous and inhalational induction of anaesthesia in this patient. (40%)

c) How may the incidence of post-operative nausea and vomiting be reduced in this child? (10%)
Considerations Pre op

- Hypovolaemia,
- risk of pulmonary aspiration (swallowed blood with or without oral intake),
- potential difficult intubation (excessive bleeding obscuring the view with or without oedema earlier airway instrumentation
- a second general anaesthetic, and the stress to both child and parents.
- Blood loss is because of venous or capillary ooze from the tonsillar bed and is difficult to measure, as it occurs over several hours and is partly swallowed.
- Excessive blood loss may lead to the child spitting blood. In these cases, the child is likely to be seriously hypovolaemic and anaemic,
- Tachycardia, tachypnoea, delayed capillary refill, and decreased urine output are early indicators of hypovolaemia,
- hypotension and altered sensorium are indicators of advanced volume depletion.
Intra op

- Preoperative resuscitation, even if this requires the insertion of an interosseous needle.
- Induction of anaesthesia in a hypovolaemic child can precipitate cardiovascular collapse.
- Haemoglobin and coagulation variables should be checked.
- Blood and blood products should be available

Equipment needed
- a selection of laryngoscope blades,
- smaller than expected tracheal tubes,
- two suction catheters should be immediately available
- Preoxygenation and rapid sequence induction with slight head-down positioning of the patient ensures rapid control of the airway and protection from pulmonary aspiration.
- Consideration should be given to adopting the left lateral position if bleeding is excessive.
You are asked to review a 2 year-old child admitted to the Emergency Department with status epilepticus.

a) Define status epilepticus. (10%)

b) Outline your initial management plan to deal with this patient. (50%)

c) List the common causes of status epilepticus in children. (30%)
Initial management NICE 2011

- ABCD
  - Emphasis on establishing a patent airway/provision of high flow oxygen/checking blood glucose
  - IV or IO access

- Cessation of convulsions
  - Lorazepam 0.1mg/kg IV/IO or Diazepam 0.5mg/kg PR
  - After 10 minutes, one further dose of lorazepam 0.1mg/kg
  - Early senior input
  - 10 min after second benzodiazepine dose, phenytoin 20mg/kg IV+/-

- Paraldehyde 0.4ml/kg PR, or phenobarbitone 20mg/kg if patient already on phenytoin
  - RSI
<table>
<thead>
<tr>
<th>Time</th>
<th>Seizure starts</th>
<th>Confirm clinically that it is an epileptic seizure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 mins</td>
<td>Check ABC, high flow O₂ if available</td>
<td></td>
</tr>
<tr>
<td>0 mins</td>
<td>Check blood glucose</td>
<td></td>
</tr>
<tr>
<td>5 mins</td>
<td>Midazolam 0.5 mg/kg buccally</td>
<td>Midazolam may be given by parents, carers or</td>
</tr>
<tr>
<td>5 mins</td>
<td>or</td>
<td>ambulance crew in non-hospital setting</td>
</tr>
<tr>
<td>5 mins</td>
<td>Lorazepam 0.1 mg/kg if intravenous access established</td>
<td></td>
</tr>
<tr>
<td>15 mins</td>
<td>Lorazepam 0.1 mg/kg intravenously</td>
<td>This step should be in hospital</td>
</tr>
<tr>
<td>15 mins</td>
<td></td>
<td>Call for senior help</td>
</tr>
<tr>
<td>15 mins</td>
<td></td>
<td>Start to prepare phenytoin for 4&lt;sup&gt;th&lt;/sup&gt; step</td>
</tr>
<tr>
<td>15 mins</td>
<td></td>
<td>Re-confirm it is an epileptic seizure</td>
</tr>
<tr>
<td>Time</td>
<td>Procedure</td>
<td>Action</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>25 mins</td>
<td>Phenytoin 20 mg/kg by intravenous infusion over 20 mins or (if on regular phenytoin) Phenobarbital 20 mg/kg intravenously over 5 mins</td>
<td>Paraldehyde 0.8 ml/kg of mixture may be given after start of phenytoin infusion as directed by senior staff Inform intensive care unit and/or senior anaesthetist</td>
</tr>
<tr>
<td>45 mins</td>
<td>Rapid sequence induction of anaesthesia using thiopental sodium 4 mg/kg intravenously</td>
<td>Transfer to paediatric intensive care unit</td>
</tr>
</tbody>
</table>
Causes of status

- Metabolic abnormalities (hypoglycaemia, hyponatraemia, hypocalcaemia)
- Febrile illness
- CNS infections (e.g. meningitis)
- Epilepsy
- Anticonvulsant withdrawal
- Trauma
- Poisoning

Report of the ILAE Task Force on Classification of Status Epilepticus

- Definition: Condition resulting from failure of the mechanisms responsible for seizure termination or from the initiation of mechanisms, (after time point t1). It is a condition, which can have long-term consequences (after time point t2), including neuronal death.
- The first is the length of the seizure and the time point (t1) beyond which the seizure should be regarded as "continuous seizure activity." The second time point (t2) is the time of ongoing seizure activity after which there is a risk of long-term consequences. tonic-clonic (t1 is 5 min and t2 is 30 min
A 4 year-old (20kg) girl is admitted with acute appendicitis and is scheduled for urgent surgery. She has been vomiting for two days and is pyrexial 38.7 °C. Her pulse rate is 170 beats per minute with a capillary refill time of 4 seconds.

a) Describe the perioperative intravenous fluid management of this case. (60%) b) Outline the metabolic and clinical complications that can occur with inappropriate intravenous crystalloid therapy. (30%)
# Assessing dehydration in children under 5 years

Use this table to detect clinical dehydration and shock during remote and face-to-face assessments. Adapted from ‘Diarrhoea and vomiting in children’ (NICE clinical guideline 84). The quick reference guide and full guidance are available from: [www.nice.org.uk/CG84](http://www.nice.org.uk/CG84)

<table>
<thead>
<tr>
<th>Increasing severity of dehydration</th>
<th>No clinically detectable dehydration</th>
<th>Clinical dehydration</th>
<th>Clinical shock</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Symptoms</strong> (remote and face-to-face assessments)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appears well</td>
<td>Appears to be unwell or deteriorating</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Alert and responsive</td>
<td>Altered responsiveness (for example, irritable, lethargic)</td>
<td>Decreased level of consciousness</td>
<td></td>
</tr>
<tr>
<td>Normal urine output</td>
<td>Decreased urine output</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Skin colour unchanged</td>
<td>Skin colour unchanged</td>
<td>Pale or mottled skin</td>
<td></td>
</tr>
<tr>
<td>Warm extremities</td>
<td>Warm extremities</td>
<td>Cold extremities</td>
<td></td>
</tr>
<tr>
<td><strong>Signs</strong> (face-to-face assessments)</td>
<td>Alert and responsive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin colour unchanged</td>
<td>Skin colour unchanged</td>
<td>Pale or mottled skin</td>
<td></td>
</tr>
<tr>
<td>Warm extremities</td>
<td>Warm extremities</td>
<td>Cold extremities</td>
<td></td>
</tr>
<tr>
<td>Eyes not sunken</td>
<td>Sunken eyes</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Moist mucous membranes (except after a drink)</td>
<td>Dry mucous membranes (except for ‘mouth breather’)</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Normal heart rate</td>
<td>Tachycardia</td>
<td>Tachycardia</td>
<td></td>
</tr>
<tr>
<td>Normal breathing pattern</td>
<td>Tachypnoea</td>
<td>Tachypnoea</td>
<td></td>
</tr>
<tr>
<td>Normal peripheral pulses</td>
<td>Normal peripheral pulses</td>
<td>Weak peripheral pulses</td>
<td></td>
</tr>
<tr>
<td>Normal capillary refill time</td>
<td>Normal capillary refill time</td>
<td>Prolonged capillary refill time</td>
<td></td>
</tr>
<tr>
<td>Normal skin turgor</td>
<td>Reduced skin turgor</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Normal blood pressure</td>
<td>Normal blood pressure</td>
<td>Hypotension (decompensated shock)</td>
<td></td>
</tr>
</tbody>
</table>

**Box 1. At increased risk of dehydration:**
- Children younger than 1 year, especially those younger than 6 months
- Infants who were of low birth weight
- Children who have passed six or more diarrhoeal stools in the past 24 hours
- Children who have vomited three times or more in the past 24 hours
- Children who have not been offered or have not been able to tolerate supplementary fluids before presentation
- Infants who have stopped breastfeeding during the illness
- Children with signs of malnutrition.

**Suspect hyperatraemic dehydration if there are any of the following:**
- Jittery movements
- Increased muscle tone
- Hypertension
- Convulsions
- Drowsiness or coma.

**Laboratory investigations:**
- Do not routinely perform blood biochemistry.
- Measure plasma sodium, potassium, urea, creatinine and glucose concentrations if:
  - Intravenous fluid therapy is required or
  - There are symptoms or signs suggesting hyperatraemia.
- Measure venous blood acid–base status and chloride concentration if shock is suspected or confirmed.
- **Pre op** – Assessment of dehydration
  - Fluid bolus 20ml/kg NaCl/CSL

- **Intra op** –
  - Calculation and correction of deficit. Fasting period, insensible losses 10ml/kg/hour per body cavity. (5ml/kg hour for brain)
  - Maintenance fluids

- **Post op** –
  - Likely to remain NBM so will need maintenance fluids
  - Post op Ileus
  - Serum urea and electrolytes at least every 24 hours
  - Blood glucose at least every 24 hours
  - Daily weight
  - Fluids input, output and balance
  - Assessment of fluid status
  - Assessment of ongoing losses (eg. gastrointestinal losses)
Maintenance fluids:

- 4mls/kg for first 10 kg 2mls/kg for next 10kg 1ml/kg for each extra kg
  - 4x10 = 40
  - 2x10 = 20
  - 1X5 = 5

Or per day - 100mls/kg/day for first 10kg
- 50mls/kg/day for next 10kg
- 20mls/kg/day for each extra kg
- which gives 1600mls/day

- NICE guidleines
Again in April 2008…..

- A 4 year old (20kg) is admitted with acute appendicitis and is scheduled for urgent surgery. She has been vomiting for 2 days, is pyrexial, has a tachycardia of 170 bpm and prolonged capillary refill.

  - a) Describe the perioperative fluid management of this case using intravenous crystalloids. (60%)
  - b) Outline the complications that can occur with inappropriate intravenous crystalloid therapy. (30%)

And Oct 05…

- Describe the perioperative fluid and electrolyte management of a 6 month old child presenting in casualty with abdominal distention requiring urgent laparotomy.
All health care professionals have a responsibility to act if they suspect that a child has been subjected to physical abuse.

a) In what situations may the anaesthetist encounter possible child abuse? (20%)

b) List the clinical features that would arouse suspicion that physical child abuse has occurred. (40%)

c) What should the anaesthetist do if they suspect child abuse has taken place? (30%)

- a) Trauma, A&E. Routine pre op interaction
- B) Delay in seeking medical help or no medial help sought
- Inconsistencies in history and/or examination
- Vauge history lacking detail or story differs each time told.
- parents may be more concerned about their own problems than about the child's injuries, and they may be hostile and leave before the discussion is finished.
- The interaction between child and parents may be abnormal and the child may be sad, afraid or even withdrawn.
- Inconsitsent with developmental age
- Accidental bruises commonly occur over bony prominences;
- bruising on other sites is more suspicious. Certain injuries are inherently suspicious.
- Bruising to the outer ear may happen when the ear is "boxed" or compressed against the side of the skull by a blow or when the margin of the ear is pinched.
- Fresh or healed tears of the frenulum of the upper lip are caused by a blow to the mouth or by a feeding bottle being forced into the mouth.
C) Hospitals generally have designated child protection doctors, nurses, and midwives to whom more serious concerns can be raised and cases discussed both formally and informally.

There should also be an on call rota for emergency referrals,

This often involves the on call consultant paediatrician who also has a clear safeguarding role, and may be the first person to consult, particularly out of hours.

Children’s social care services, police, and the court are generally approached by a senior paediatrician or by the child protection team. In England, detailed information on the entire process is described in ‘Working Together to Safeguard Children’ which includes a Common Assessment Framework.

Anaesthetic trainees and staff or associate specialist anaesthetists are generally advised to discuss safeguarding matters with a supervising consultant anaesthetist in the first place. If there is a physical sign which cannot be easily interpreted with certainty, a visual inspection by a consultant paediatrician is acceptable whilst the child is under anaesthesia.
Anaesthetist has concerns about child’s welfare
(inform surgical team)

Discuss with consultant paediatrician, named or designated doctor/nurse for child protection (CP) as appropriate

Still has concerns

Consultant paediatrician and anaesthetist have discussion with parents and the child when surgery completed

Concerns remain

Ensure documentation is complete

Assessment made, CP procedures follow

No longer has concerns

No further CP action

Ensure documentation complete

A 12 year old girl is admitted for prominent ear correction as a day case. She is very anxious and uncooperative when you see her preoperatively. She will not engage with any attempts to calm her down and subsequently refuses to cooperate with anaesthetic induction. However, her mother is insistent that you go ahead with the anaesthetic.

a) What strategies are available and appropriate to decrease preoperative anxiety in children for day case surgery? (45%)

b) How would you proceed with this scenario? Explain your reasoning. (45%)
Preinduction techniques to relieve anxiety in children undergoing general anaesthesia


- Preinduction techniques, aimed at reducing preoperative anxiety, consist of:
  - (i) sedative premedication,
  - ii) parental presence at induction of anaesthesia,
  - (iii) behavioural intervention.
Regarding caudal anaesthesia in children:

a) What anatomical features are important to consider when performing the block (caudal) safely? (30%)

b) What are the contraindications? (20%)

c) What are the problems and complications? (20%)

d) What constraints limit the effectiveness of the block and how can they be overcome? (20%)
<table>
<thead>
<tr>
<th>ADULTS</th>
<th>CHILDREN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dura ends at S2</td>
<td>Dura ends at S4 at birth (S2 by approx. 2 years old)</td>
</tr>
<tr>
<td>Sacral fat pad</td>
<td>Easier to feel sacral hiatus</td>
</tr>
<tr>
<td>Epidural fat dense (difficult to achieve a higher block)</td>
<td>Epidural fat loose, less fibrous in epidural space, so local anaesthetic spreads well</td>
</tr>
<tr>
<td>Possibly more likely to see a drop in BP with sympathetic block</td>
<td>Delay in ANS maturation, so cardiovascular stability seen</td>
</tr>
</tbody>
</table>
Congenital heart disease

- Congenital heart defects can be cyanotic or acyanotic.
- a) What do these terms refer to? (4 marks)
- b) Give 4 examples of each (8 marks)
- c) What is Eisenmenger’s syndrome? Describe the cardiac abnormality (8 marks)
### Acyanotic
- L-R shunt
- ASD, VSD, AVSD,
- Patent Ductus Arteriosus;

### Cyanotic
- R-L shunt
- Tetralogy of Fallot,
- Transposition of the Great Arteries, Truncus Arteriosus,
- Tricuspid Atresia,
- Ebstein’s Anomaly
Eisemenger’s syndrome

- Chronic L to R Shunt caused by a congenital heart defect e.g. VSD
- Causes pulmonary hypertension
- Chronic R to L shunt resulting in RV overload and RVH
- Chronic Pulmonary overcirculation
- Eventual reversal of the shunt which becomes predominantly Right to Left
- Presents with cyanosis, heart failure, polycythaemia
You are scheduled to anaesthetise a 15 year-old girl for correction of her idiopathic scoliosis.

What are the key (a) preoperative (25%), (b) intraoperative (40%), and (c) postoperative (25%) issues in your anaesthetic management of this patient?
<table>
<thead>
<tr>
<th>Category</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idiopathic (70%)</td>
<td>Early onset (infantile)</td>
</tr>
<tr>
<td></td>
<td>Late onset (juvenile/adolescent)</td>
</tr>
<tr>
<td>Neuromuscular (15%)</td>
<td>Cerebral palsy</td>
</tr>
<tr>
<td></td>
<td>Myopathies</td>
</tr>
<tr>
<td></td>
<td>Poliomyelitis</td>
</tr>
<tr>
<td></td>
<td>Syringomyelia</td>
</tr>
<tr>
<td></td>
<td>Friedreich's ataxia</td>
</tr>
<tr>
<td>Congenital</td>
<td>Vertebral anomalies</td>
</tr>
<tr>
<td></td>
<td>Rib anomalies</td>
</tr>
<tr>
<td></td>
<td>Spinal dyraphism</td>
</tr>
<tr>
<td>Traumatic</td>
<td>Vertebral fractures</td>
</tr>
</tbody>
</table>
Pre-op
  ◦ Cardio-respiratory dysfunction may exist as a result of progressive scoliosis or be related to coexisting disease, therefore careful preoperative assessment is required

  ◦ Curvature is measured using the Cobb angle. A lateral curve of $>10^\circ$ is considered abnormal.1
<table>
<thead>
<tr>
<th>Routine investigations</th>
<th>Additional investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain chest X-ray</td>
<td>Arterial blood gases—if spirometry not possible</td>
</tr>
<tr>
<td>Pulmonary function tests—FEV1 and FVC</td>
<td>ECG and Echocardiography (non-idiopathic scoliosis)</td>
</tr>
<tr>
<td>Blood tests—Full blood count</td>
<td></td>
</tr>
<tr>
<td>Coagulation screen</td>
<td></td>
</tr>
<tr>
<td>Urea and electrolytes</td>
<td></td>
</tr>
<tr>
<td>Calcium and phosphate</td>
<td></td>
</tr>
<tr>
<td>Blood cross-match</td>
<td></td>
</tr>
</tbody>
</table>
Intra-op

- The aim is to maintain a stable anaesthetic depth allowing for intraoperative neurophysiological monitoring.
- It can be achieved using various anaesthetic techniques:
  - i.v. induction of propofol followed by a non-depolarizing neuromuscular blocking drug and tracheal intubation with an armoured tracheal tube. Anaesthesia is maintained by sevoflurane at 0.6 MAC in air and oxygen, with an infusion of remifentanil. A bolus of i.v. morphine is given towards the end of surgery.
  - Succinylcholine is contraindicated in patients with muscular dystrophy because of the risk of rhabdomyolysis, hyperkalaemia and cardiac arrest.
  - Considerations include the prone position, avoiding hypothermia, minimizing blood loss and monitoring spinal cord function.
  - Invasive monitoring lines and catheters along with postoperative analgesia plan should be explained fully to the patient and family.
- Sedative premedication with oral midazolam (0.5 mg kg⁻¹) can be offered.
Post op

- Good postoperative pain control is essential and requires a multimodal approach.
- Patients with Duchenne muscular dystrophy may be on corticosteroid therapy and require perioperative supplementation.
Describe the anaesthesia and analgesia considerations in a child presenting for elective day case orchidopexy.

April 2002

Describe the anaesthetic management of a penetrating eye injury in a screaming 5 year old child.
A one day old term neonate has arrived at your regional paediatric intensive care unit. A congenital diaphragmatic hernia has been diagnosed. The baby is already intubated and receiving artificial ventilation. Outline, with reasons, the principles of preoperative management.
The severity of the condition varies widely, the degree of pulmonary hypoplasia and pulmonary hypertension largely determining outcome.

After recent advances in the care of these patients, several centres are now reporting survival rates >80%.

This improved survival is ascribed to increased knowledge of the pathophysiology of the condition and, consequently, better perioperative management.

Association of CDH with major cardiac or skeletal anomalies is associated with a relatively poor prognosis, so fetal echo mandatory.

Exclusion of a chromosomal abnormality may require amniocentesis.

Routine Caesarean delivery of prenatally diagnosed CDH infants does not confer any benefits over vaginal delivery.

Delivery should be as close to term as possible to maximize pulmonary maturity and in a centre that has the experienced personnel and resources necessary to care for the critically ill neonate.
aggressive bag and mask ventilation should be avoided to prevent gut distension.

The infant should be intubated and ventilated

large bore nasogastric tube is passed to decompress the intrathoracic bowel.

Barotrauma, which will further damage the hypoplastic lung, must be avoided; peak inspiratory pressures should not exceed 25 cm H2O.

It has become clear that the timing of surgery per se does not affect survival

optimization of clinical parameters before embarking on surgical repair is necessary to ensure the best outcome

most centres that have achieved high survival rates limiting the peak inspiratory pressures to <25 cm H2O; tolerating hypercapnia

survival in infants with CDH has improved considerably since the avoidance of hyperventilation and barotrauma, whether this ‘gentle ventilation’ is achieved using conventional ventilation or HFOV

NO and ECMO may improve survival however no overall benefit between centres who offer these.
Surgical Repair

- Surgical repair of CDH was treated as a neonatal emergency up until the 1980s.
- But, repair of the defect does not result in an improvement in gas exchange, and thoracic compliance and PaCO2 tend to deteriorate in the immediate postoperative period.
- Most centres now delay surgery for at least 24–48 h after admission, to allow for a period of clinical stabilization and a fall in pulmonary vascular resistance.
- Repair is usually achieved via an abdominal incision with gentle reduction of the abdominal viscera from the thorax. The diaphragmatic defect is either closed by primary repair or, in the case of a large defect, using a prosthetic patch.
May 01 - Burns

- Outline the early management of a one year old child with 25% burns caused by scalding.
- **Superficial**: limited to the epidermis, resulting in a painful erythematous burn rarely requiring hospital treatment, usually healing within 5 days. These burns are not included in estimates for fluid resuscitation.

- **Partial thickness**: these are significant burns, counted in burn size estimates. They are subclassified into superficial and deep, although the distinction is often difficult. Superficial is similar to the above, but damage extends to the dermis, causing blistering. Deeper partial thickness burns are a management quandary: some heal without surgery and some require immediate excision and grafting to achieve healing within a suitable time frame.

- **Full thickness**: the dermis is destroyed, leaving a well-demarcated burn, which may initially appear dark red, later dull yellow. They are insensate and will only heal with skin grafting.
Management

- Adequate, early fluid resuscitation to maintain organ perfusion and control the extent of the burn injury itself.
- Children suffer higher evaporative heat and fluid losses.
- Analogous to the benefit of early fixation of fractures, excision, and cover of non-viable skin reduces morbidity, mortality, and the extent of inflammatory response.4
- Adequate, pain management is an obligation and may help to alleviate psychological sequelae
- Trauma ‘ABC’
  - namely site, depth, and extent.
  - Background history events leading up to the injury, other injuries, conscious state, smoke inhalation or thermal injury of the upper airway, medical problems, vaccination status, and allergies.
- Burn centre proforma
  - All burns require immediate cooling to halt the burning process; prolonged cooling of burns >15% BSA risks hypothermia in children.
  - Once described, the burn should be covered with a sterile non-adherent dressing. Nearly all burns are extremely painful, potent analgesia should be made available early in the management and titration of opioids to effect is the best approach.
Parkland formula

For the first 24 h after the burn, give 4 ml kg$^{-1}$ per % BSA burn Hartmann's solution, half of this volume in 8 h post-burn, the other half in the next 16 h.

Maintenance

Use, for example, Hartmann's solution:

- 4 ml kg$^{-1}$ h$^{-1}$ for the first 10 kg body weight
- 2 ml kg$^{-1}$ h$^{-1}$ for the next 10 kg body weight
- 1 ml kg$^{-1}$ h$^{-1}$ for each kg body weight above 20 kg (Glucose containing i.v. fluids are not generally indicated though may be required for infants when early feeding cannot be established. The composition of resuscitation and maintenance fluids is the subject of current debate).
Outline the anaesthetic management of a 2 year old child who is scheduled for therapeutic bronchoscopy following inhalation of a foreign body 2 days ago. The child does not exhibit any signs of upper airway obstruction.
Nov 1999 – Pyloric Stenosis

- What is the anaesthetic management of pyloric stenosis in a 6 week old child?
Pyloric Stenosis

- Most commonly between 3-5wks old
- 1 in 250 babies, commoner in males
- Vomiting (often projectile)
- Weight loss/failure to gain weight
- Dehydration
- Palpable pyloric mass
- Hypokalaemia
- Metabolic alkalsos
- Hypochloraemia
- **Medical, not surgical emergency**
- Pyloromyotomy once rehydrated and metabolic abnormalities corrected (may take 1-3 days)
- Aspirate NG tube prior to induction
- Local anaesthetic wound infiltration