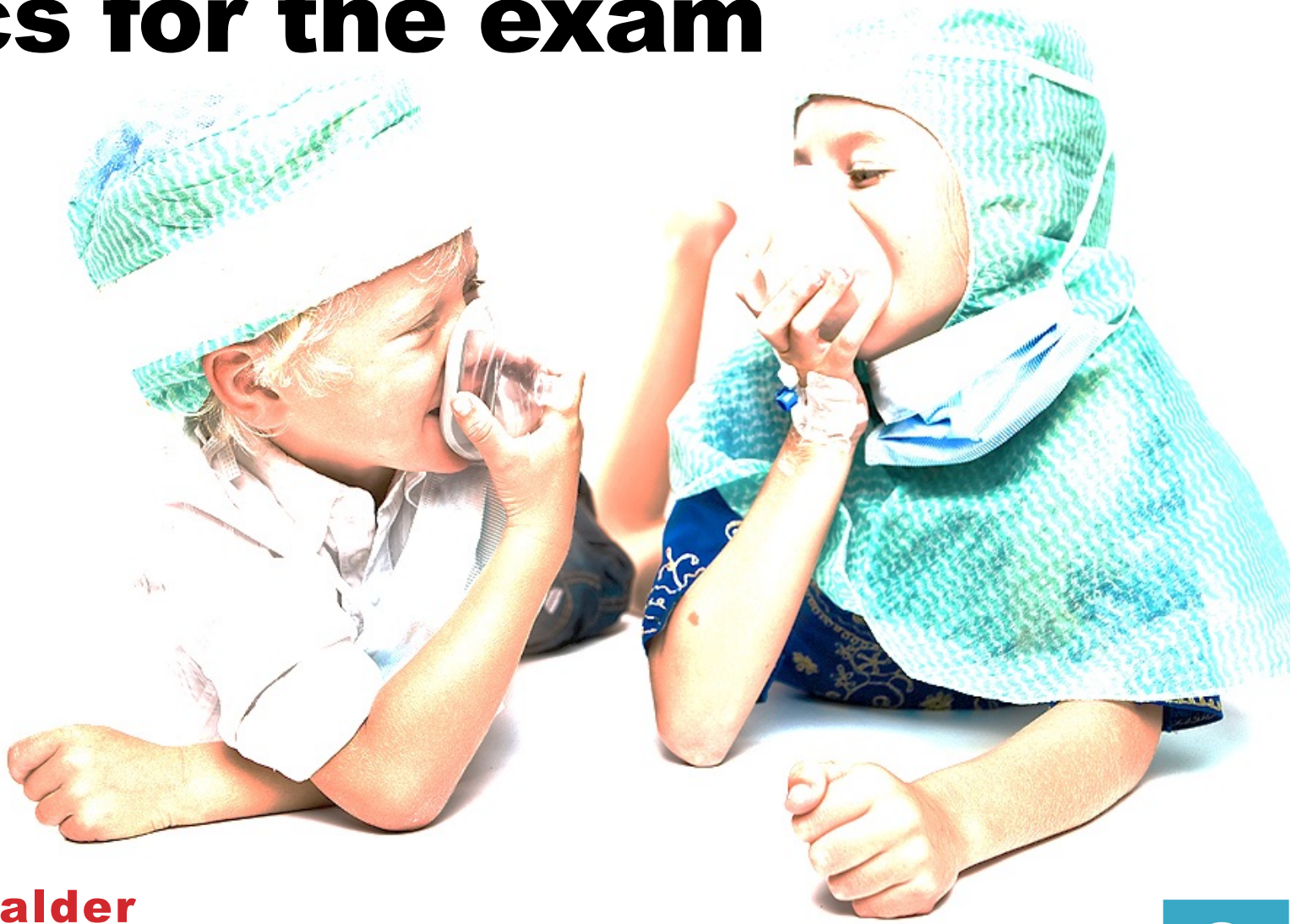
Paediatric Anaesthesia: topics for the exam



Alyson Calder

Trainee Representative, APAGBI

Previous exam topics

The unwell child

- Meningococcal septicaemia
- Sepsis, fluid therapy
- Appendicitis, fluid therapy
- Appendicectomy
- Meningococcal septicaemia
- Laparotomy, fluid therapy

Airway-related

- Croup/epiglottitis
- Stridor
- Airway in <3y
- Bleeding tonsil
- Down syndrome child for tonsillectomy
- Elective tonsillectomy
- Foreign body bronchoscopy

Peri-operative management/specific cases

- Scoliosis
- Day case orchidopexy
- Congenital diaphragmattic hernia
- Pyloric stenosis
- Squint and vagal response

Trauma

- Extradural haematoma
- Penetrating eye injury
- Scalds
- APLS

Pain management

- Caudal anaesthesia
- Post-op analgesia

Other

- Status epilepticus
- Non-accidental injury
- Pre-op anxiety

alysoncalder@doctors.org.uk, GAT April 2013

APA

Previous exam topics

The unwell child

- Meningococcal septicaemia
- Sepsis, fluid therapy
- Appendicitis, fluid therapy
- Appendicectomy
- Meningococcal septicaemia
- Laparotomy, fluid therapy

Airway-related

- Croup/epiglottitis
- Stridor
- Airway in <3y
- Bleeding tonsil
- Down syndrome child for tonsillectomy
- Elective tonsillectomy
- Foreign body bronchoscopy

Peri-operative management/specific cases

- Scoliosis
- Day case orchidopexy
- Congenital diaphragmattic hernia
- Pyloric stenosis
- Squint and vagal response

Trauma

- Extradural haematoma
- Penetrating eye injury
- Scalds
- APLS

Pain management

- Caudal anaesthesia
- Post-op analgesia

Other

- Status epilepticus
- Non-accidental injury
- Pre-op anxiety

alysoncalder@doctors.org.uk, GAT April 2013

APA

Today's topics

1. Laryngospasm
2. Trisomy 21
3. Premature infants
4. Pyloric stenosis
5. Non-accidental injury

Today's topics

1. **Laryngospasm**
2. Trisomy 21
3. Premature infants
4. Pyloric stenosis
5. Non-accidental injury

The Royal College of Anaesthetists

INTERMEDIATE SYLLABUS

PA_IS_06

Demonstrates strategies for, and the practical management of anaesthetic emergencies in children (e.g. laryngospasm)

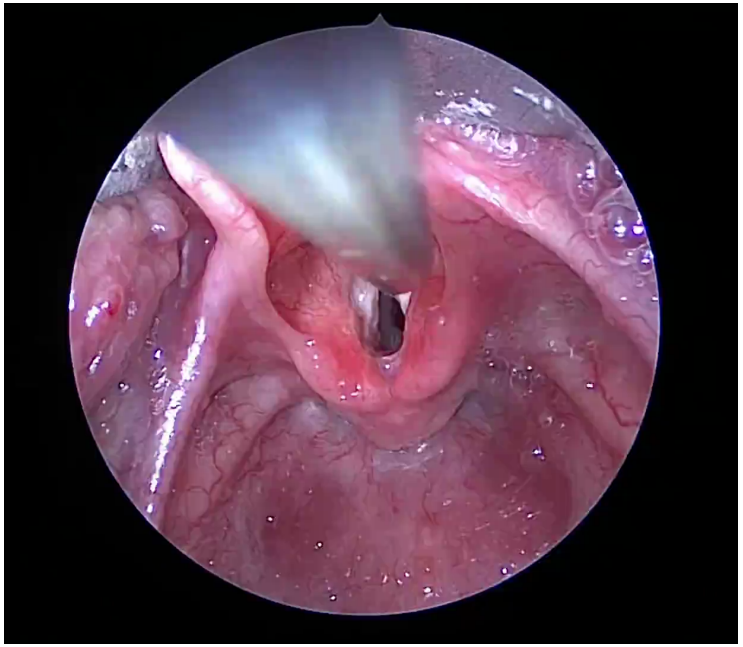
alysoncalder@doctors.org.uk, GAT April 2013

APA

Laryngospasm

Closure of the vocal cords

Arytenoids and epiglottis may tilt inwards towards glottis



Laryngospasm

Warning signs

cough, breath hold, straining abdomen

Paradoxical chest wall motion

Recessions, Tracheal tug

Loss of capnography

Bag not moving

Partial closure:

stridor

Complete closure:

no noise

alysoncalder@doctors.org.uk, GAT April 2013

Laryngospasm

Stimulation

↓

Glottic closure

↓

Airway obstruction

↓

Hypoxia

↓

Bradycardia

↓

Low CO

↓

Arrest

alysoncalder@doctors.org.uk, GAT April 2013

APA

Laryngospasm

Risk factors

Young age

URTI (esp. if within 2w: x10 risk)

Asthma

Atopy

Passive smoking

Airway surgery

Light anaesthesia

Inhalational (cf. IV induction)

Iso/des

alysoncalder@doctors.org.uk, GAT April 2013

Laryngospasm

1. **CPAP**

100% O2, Jaw thrust, [Head tilt, chin lift]

CPAP [assist inspiratory effort/rapid bag squeezing]

[Gentle suction if secretions heard]

2. **DEEPEN**

Propofol 1-3mg/kg

3. **PARALYSE**

Suxamethonium 0.5-2mg/kg

Atropine 0.01mg/kg = 10mcg/kg (may be given before sux to avoid brady)

If no IV: IM sux (4mg/kg) into deltoid and atropine (20mcg/kg)

4. **OTHER**

May require ETT & OG (to deflate stomach)

After the event: inform parents

alysoncalder@doctors.org.uk, GAT April 2013

Laryngospasm

Best management is prevention:

Manage high risk cases expectantly

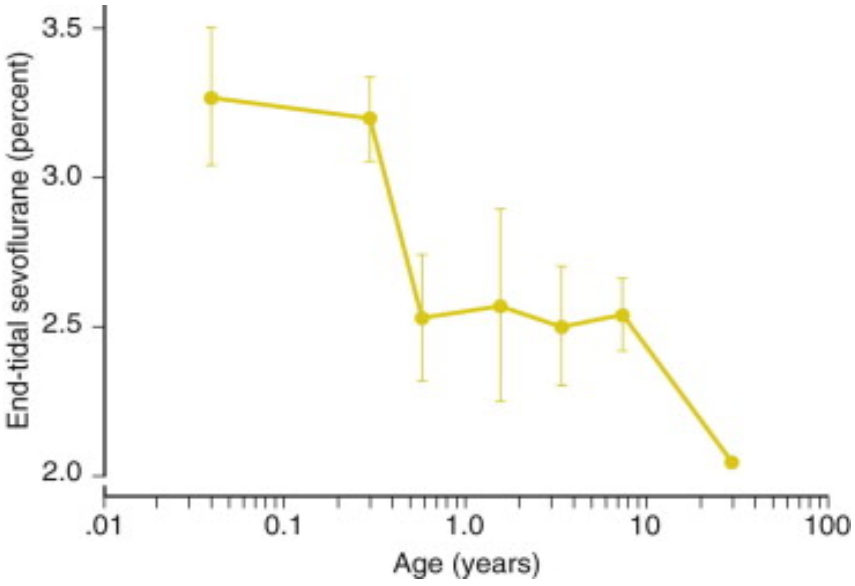
Avoid stimulation if light

Suction airway

Pre-extubation oxygenation

Wide-awake extubation

Topical/IV lidocaine?



Lerman J *et al.* The pharmacology of sevoflurane in infants and children. *Anesthesiology* 1994;80:814-24

Erb TO, von *et* al. The effect of intravenous lidocaine on laryngeal and respiratory reflex responses in anaesthetised children. *Anaesthesia* 2013;68(1):13-20

[and accompanying editorials]

n=39

2-7y

Inhalational induction

Sprayed 0.25ml water onto vocal cords before, 2 mins and 10 mins after IV lidocaine 2mg/kg

38% had laryngospasm before, 15% at 2 min, 18% at 10 min

Short-lived effect

Laryngospasm: further reading

Paediatric Anaesthesia 2008;18(4)

Anaesthesia 2013;68(1)

Today's topics

1. Laryngospasm
2. **Trisomy 21**
3. Premature infants
4. Pyloric stenosis
5. Non-accidental injury

APA

The Royal College of Anaesthetists

INTERMEDIATE SYLLABUS

PA_IK_03

Explain the implications of paediatric medical and surgical problems including … syndromes (e.g. Down's) for anaesthesia

alysoncalder@doctors.org.uk, GAT April 2013

APA

Trisomy 21 (Down's syndrome)

Airway

Narrow nasopharynx

Hypoplastic midface

Micrognathia

Large T & A

Macroglossia

OSA

} Prone to obstruction

Subglottic stenosis

GORD

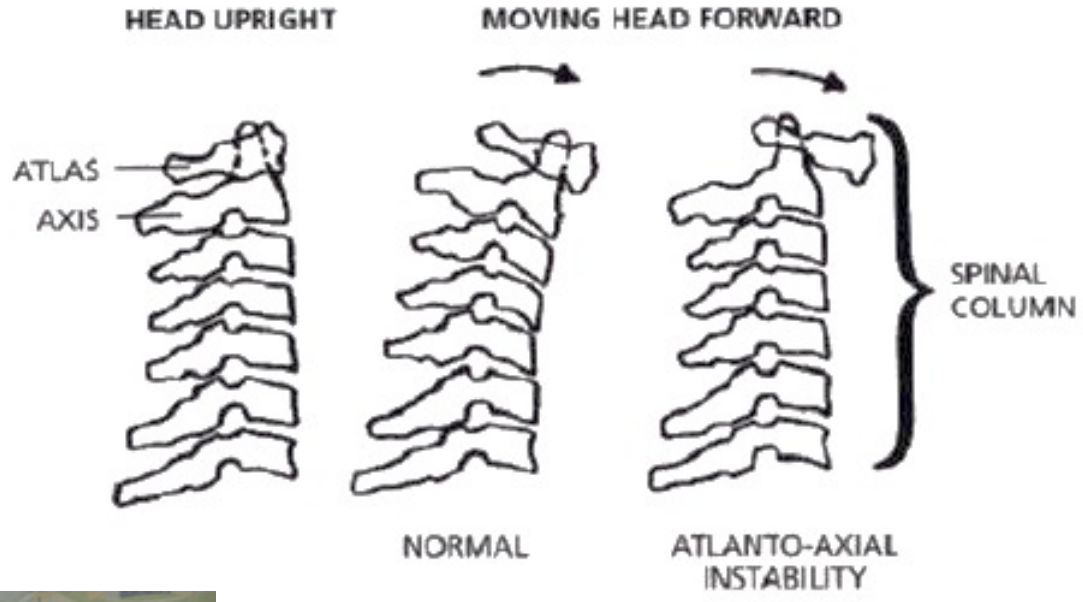
Post-op obstruction

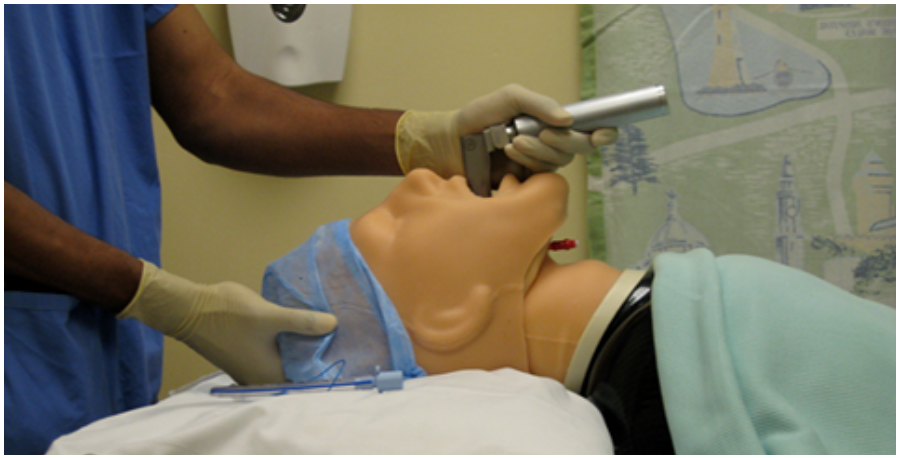
Trisomy 21 (Down's syndrome)

Neck

Atlanto-axial instability

Occipito-atlantal instability





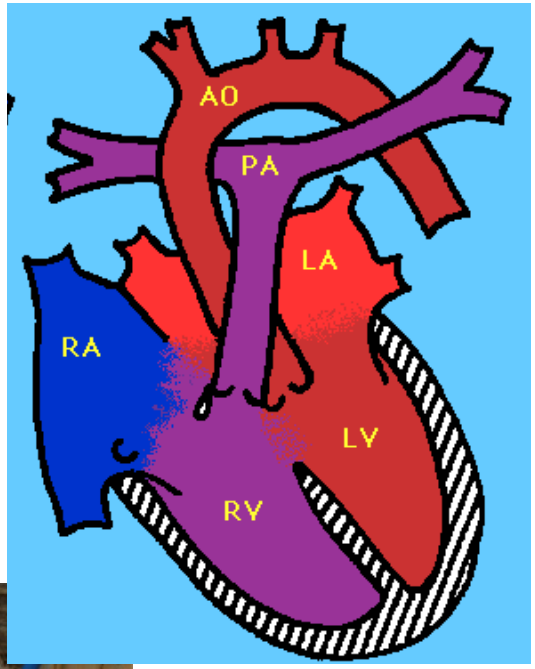
Trisomy 21 (Down's syndrome)

Cardiac

AVSD/VSD/PDA/TOF

Pulmonary hypertension

Bradycardia (esp. induction)



Neuro

Variable cooperation

Hypotonic

Intravenous cannulation

Difficult veins

alysoncalder@doctors.org.uk, GAT April 2013

APA

Down's Sy: further reading

CEACCP 2003; 3 (3)

Today's topics

1. Laryngospasm
2. Trisomy 21
3. **Premature infants**
4. Pyloric stenosis
5. Non-accidental injury

INTERMEDIATE SYLLABUS

PA_IK_12

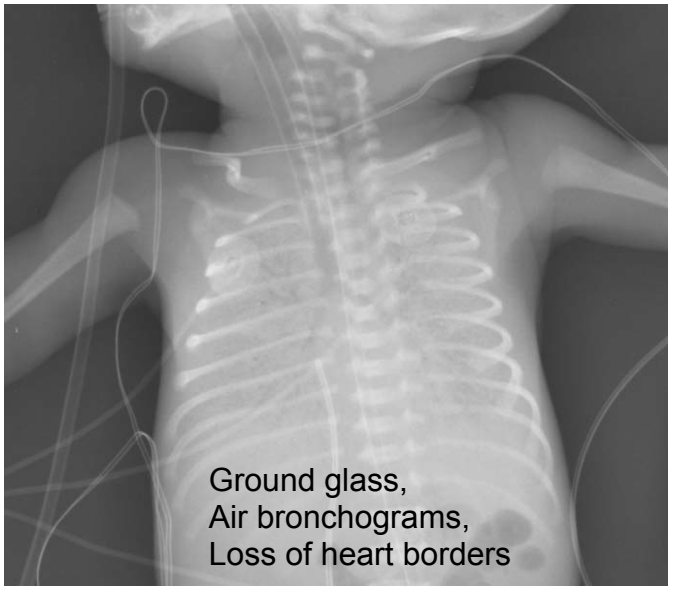
Describes the special problems of the premature and ex-premature neonate

Respiratory Distress Syndrome

Respiratory Distress Syndrome

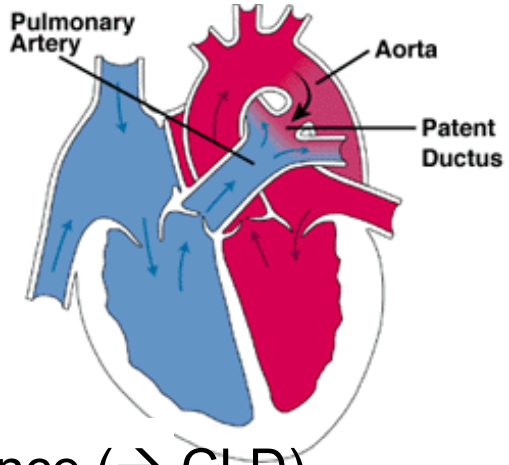
- Surfactant deficiency, immature alveoli
- Resp. distress, ↑WOB
- ↓compliance, atelectasis, V/Q mismatch
- Risk of LRTI, barotrauma, BPD
- BPD (chronic lung disease): emphysema, collapse, fibrosis, pulmonary arteriole thickening
- Implications:
  - High RR, Short Insp
  - Small TV
  - Avoid equipment deadspace
  - Post-op apnoeas


CPAP/IPPV


Ground glass,
Air bronchograms,
Loss of heart borders

alysoncalder@doctors.org.uk, GAT April 2013

Patent Ductus Arteriosus

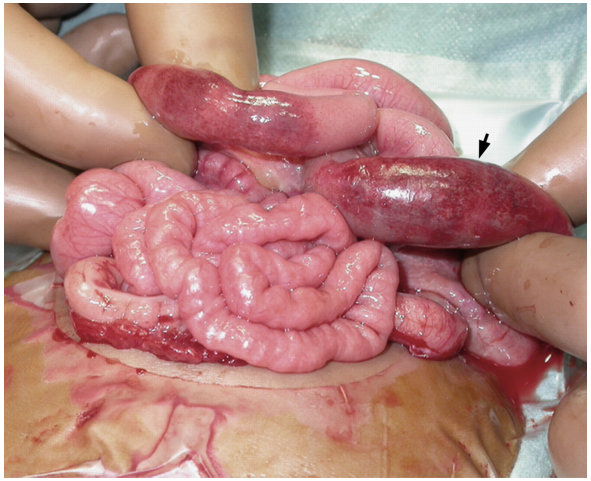


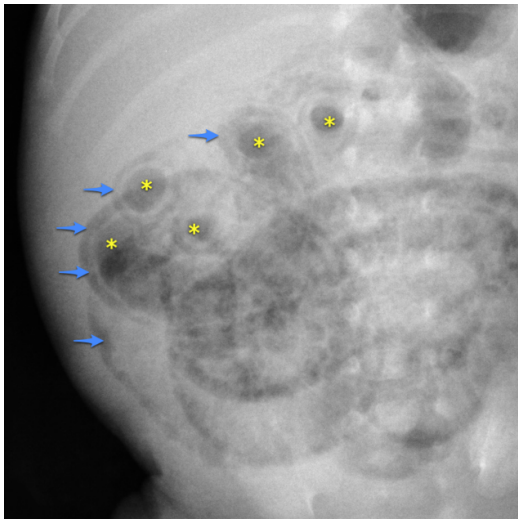
- **May want to keep it open**
  - 'Duct dependent' circulation (e.g. Coarctation)
  - Prostaglandin
- **May want to close it**
  - Pulmonary overcirculation, ↓systemic perfusion
  - Causes ↓BP, cardiac failure, ventilator dependence (→ CLD), feed intolerance, necrotising enterocolits, ?effect on cerebral perfusion
  - Medical tx: diuretics, COX-I (e.g. ibuprofen/indomethacin)
  - Endovascular device
  - Surgery (L thoracotomy)
  - Complications:
    - Mistaken anatomy
    - Post-ligation cardiac syndrome
    - Recurrent LN damage, Phrenic n. palsy
    - Chylothorax, Pneumothorax

alysoncalder@doctors.org.uk, GAT April 2013

Necrotising enterocolitis

- Presentation:
  - Distended abdomen
  - Bilious NG aspirates
  - Bloody stools
  - Intramural gas on AXR
- Bowel wall inflammation → intramural gas → wall necrosis → perforation → shock
- ↓plat, ↓Hb, ↑H^+, coagulopathic, electrolyte abN
- Conservative tx: fluids, Abx, NBM, TPN
- Laparotomy with resection and ostomy
- Implications
  - <1.5kg, unwell
  - Need fluid resus
  - Monitor Glu
  - Inotropes, Ca^{2+}
  - X match blood (friable tissue)





alysoncalder@doctors.org.uk, GAT April 2013

APA

Necrotising enterocolitis

Lonnqvist PA. Major abdominal surgery of the neonate: anaesthetic considerations. *Best Pract Res Clin Anaesthesiol* 2004;**18(2):**321-342

The awake neonatal spinal

- ↓apnoeas in at risk patients
- Avoid airway trauma
- Avoid GA on the developing brain

The effects of anaesthesia on neurodevelopmental outcome and apnoea in infants (**The GAS study**)

N= 660, ing hernia repair.

Multicentre RCT, spinal vs. GA (sevo).

Outcomes: post-op obs, neurodevelopment at 2y, IQ @ 5y

Results awaited

alysoncalder@doctors.org.uk, GAT April 2013

Today's topics

1. Laryngospasm
2. Trisomy 21
3. Premature infants
4. **Pyloric stenosis**
5. Non-accidental injury

The Royal College of Anaesthetists

INTERMEDIATE SYLLABUS

PA_IK_03

Lists common anaesthetic problems in the neonatal period and explains their perioperative anaesthetic management (e.g. pyloric stenosis)

alysoncalder@doctors.org.uk, GAT April 2013

APA

Pyloric stenosis

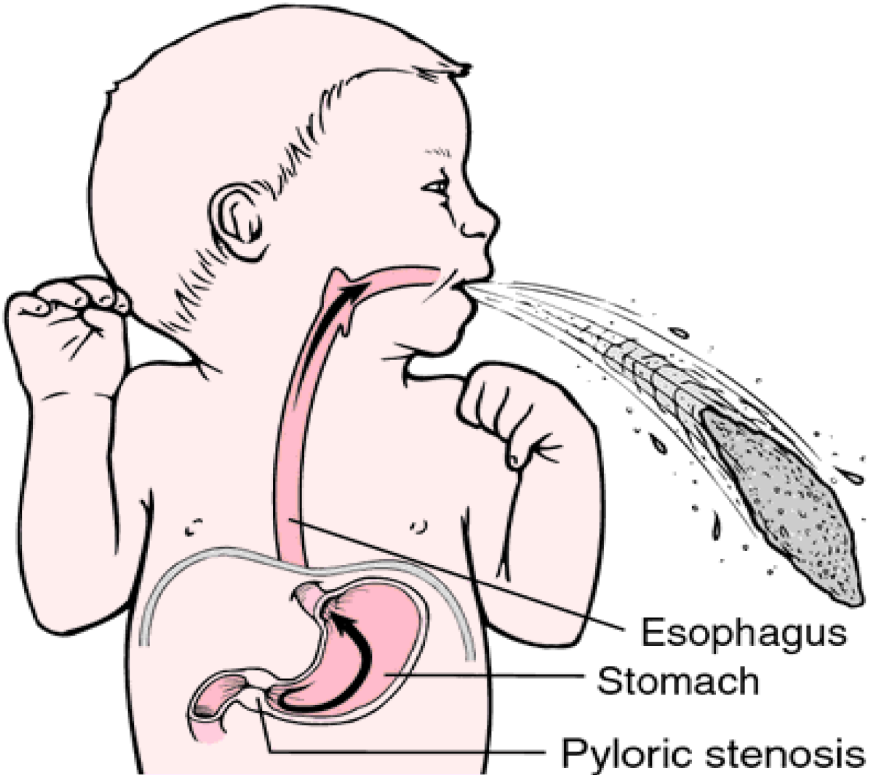
Hypertrophy pyloric muscle

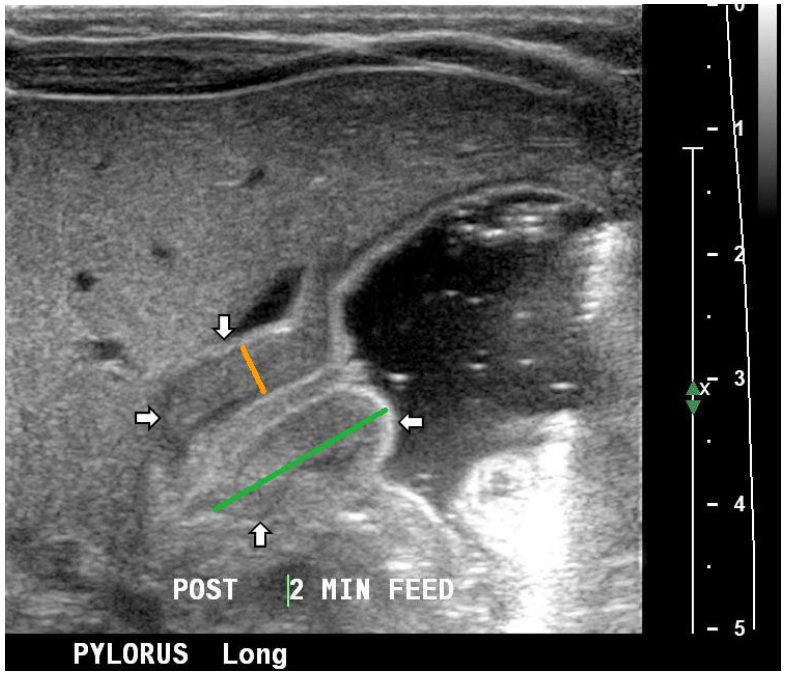
Term boys 2-8w

'Olive' of muscle

Non-bilious vomiting after feeds

Medical (not surgical) emergency





alysoncalder@doctors.org.uk, GAT April 2013

Pyloric stenosis

Blood Gas Values				
↑ pH	7.618		[7.350 - 7.450]	
↑ pCO_2	54.4	mmHg	[35.0 - 45.0]	
pO_2	164	mmHg	[-]	
↑ $cHCO_3^-(P)_c$	56.2	mmol/L	[21.0 - 28.0]	
?↑ cBase(Ecf)$_c$	30.1	mmol/L	[-3.0 - 3.0]	
sO_2	99.3	%	[-]	
Oximetry Values				
ctHb	108	g/L	[-]	
FCOHb	1.2	%	[- 6.0]	
FHHb	0.7	%	[-]	
FMetHb	1.5	%	[- 1.5]	
Hct_c	33.2	%		
Electrolyte Values				
↓ cNa^+	130	mmol/L	[134 - 146]	
cK^+	3.5	mmol/L	[3.4 - 5.0]	
↓ cCa^{2+}	0.97	mmol/L	[1.12 - 1.32]	
↓ cCl^-	72	mmol/L	[98 - 108]	
Metabolite Values				
↑ cGlu	8.7	mmol/L	[3.0 - 5.4]	
↑ cLac	1.7	mmol/L	[- 1.3]	

alysoncalder@doctors.org.uk, GAT April 2013

APA

Pyloric stenosis

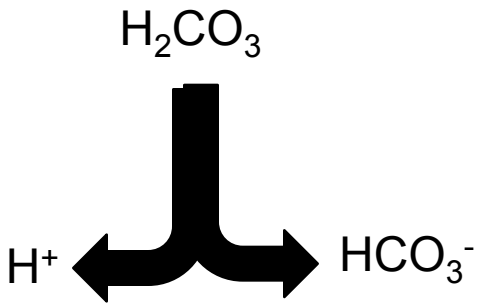
Blood Gas Values				
↑ pH	7.618		[7.350 - 7.450]	
↑ pCO_2	54.4	mmHg	[35.0 - 45.0]	
pO_2	164	mmHg	[-]	
↑ $cHCO_3^-(P)_c$	56.2	mmol/L	[21.0 - 28.0]	
?↑ cBase(Ecf)$_c$	30.1	mmol/L	[-3.0 - 3.0]	
sO_2	99.3	%	[-]	
Oximetry Values				
ctHb	108	g/L	[-]	
FCOHb	1.2	%	[- 6.0]	
FHHb	0.7	%	[-]	
FMetHb	1.5	%	[- 1.5]	
Hct_c	33.2	%		
Electrolyte Values				
↓ cNa^+	130	mmol/L	[134 - 146]	
cK^+	3.5	mmol/L	[3.4 - 5.0]	
↓ cCa^{2+}	0.97	mmol/L	[1.12 - 1.32]	
↓ cCl^-	72	mmol/L	[98 - 108]	
Metabolite Values				
↑ cGlu	8.7	mmol/L	[3.0 - 5.4]	
↑ cLac	1.7	mmol/L	[- 1.3]	

Hypochloraemic, metabolic alkalosis

alysoncalder@doctors.org.uk, GAT April 2013

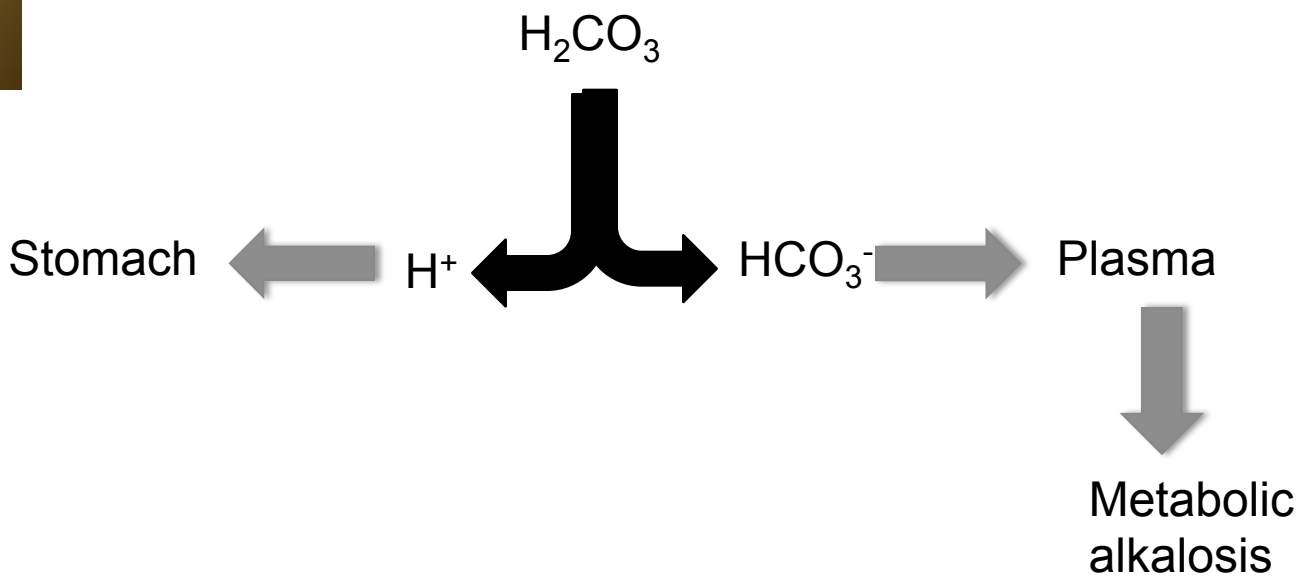
Loss of H^+Cl^-, H_2O, Na^+, K^+

Loss of H^+Cl^-, H_2O, Na^+, K^+



alysoncalder@doctors.org.uk, GAT April 2013

Loss of H^+Cl^-, H_2O, Na^+, K^+



Loss of H^+Cl^-, H_2O, Na^+, K^+

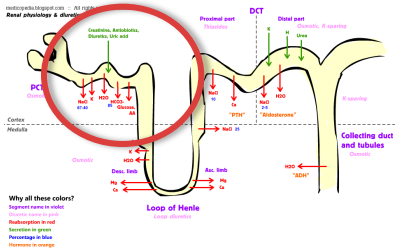
H_2CO_3

Stomach ← H^+ | HCO_3^- → Plasma

↓

Metabolic alkalosis

PCT resorption of HCO3 overwhelmed
→ alkaline urine



alysoncalder@doctors.org.uk, GAT April 2013

APA

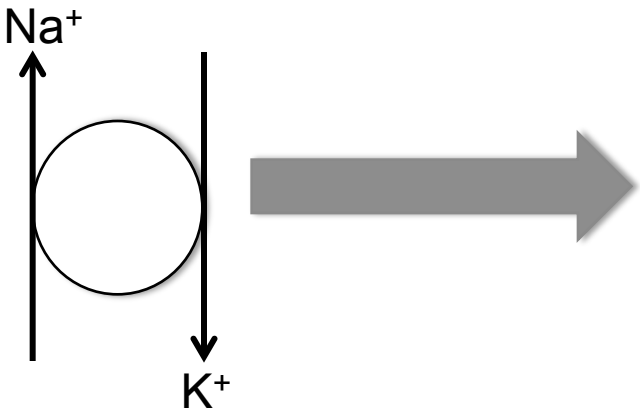
Loss of H^+Cl^-, H_2O, Na^+, K^+

H_2CO_3

Stomach ← H^+ | HCO_3^- → Plasma

Plasma → Metabolic alkalosis

ECF volume loss → R-A-A stimulation



K^+ loss in urine

↓Total body K^+

alysoncalder@doctors.org.uk, GAT April 2013

APA

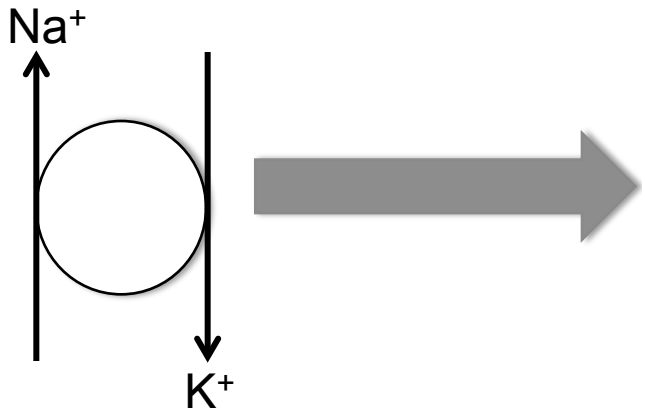
Loss of H^+Cl^-, H_2O, Na^+, K^+

Kidneys preserve ECF volume above pH
Aldosterone→

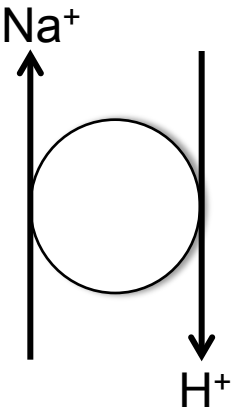
ECF volume loss

↓

R-A-A stimulation



K^+ loss in urine
↓Total body K^+



Acidic urine

alysoncalder@doctors.org.uk, GAT April 2013

Loss of H^+Cl^-, H_2O, Na^+, K^+

Hypochloraemia

Hypochloraemic hypokalaemia metabolic alkalosis

alysoncalder@doctors.org.uk, GAT April 2013

Loss of H^+Cl^-, H_2O, Na^+, K^+

Can't correct alkalosis until correct the low chloride

Hypochloraemia

Hypochloraemic hypokalaemia metabolic alkalosis

Has to be enough Cl^- in the glomerular filtrate to allow tubular exchange with $HCO3^-$ to excrete it

Pyloric stenosis: Mx

NBM, NG tube

Correct dehydration

Correct electrolytes

Targets:

- Rehydrated
- HCO_3 <30mmol/L
- Cl^- > 100mmol/L
- urine Cl^- >20mmol/L

If operate before this:

- Dysrythmias
- Apnoeas
- Hypotension

alysoncalder@doctors.org.uk, GAT April 2013

Pyloric stenosis

Anaesthetic

- Suction NG in all 4 quadrants
- IV induction (+ cricoid)
- IV paracetamol
- LA infiltration to wound
- Awake extubation

- Post op:
  - monitor for apnoeas
  - hypoglycaemia
  - pain

Pyloric stenosis

CEACCP 2001; 1: 85-88

Today's topics

1. Laryngospasm
2. Trisomy 21
3. Premature infants
4. Pyloric stenosis
5. **Non-accidental injury**

APA

The Royal College of Anaesthetists

BASIC SYLLABUS

CP_BK_01 – 06

Understanding of NAI: importance, signs and appropriate actions

alysoncalder@doctors.org.uk, GAT April 2013

APA

Safeguarding

We may encounter NAI in:

- Resus
- ICU
- Elective surgery
- Emergency surgery
- Forensic examination

Safeguarding

Concerning features

- Inadequate/incongruous/changing history
- Bruising
- Cigarette burns
- Bite marks
- Inaccessible places
- Intra-oral trauma
- Intra-oral frenulum damage

Non-accidental injury

alysoncalder@doctors.org.uk, GAT April 2013

Non-accidental injury

Non-accidental injury

Non-accidental injury

Safeguarding

Actions to take

- Act in the child's best interests
- Consult senior/CP expert
- Do NOT undertake additional/intimate/invasive examination (requires additional consent)
- Respect confidentiality

We should **all** have Level 2 CP Training

Child Protection and the Anaesthetist: Safeguarding Children in the Operating Theatre

Intercollegiate Document

March 2007

Royal College of Paediatrics and Child Health

alysoncalder@doctors.org.uk, GAT April 2013

APA

Today's topics

1. Laryngospasm
2. Trisomy 21
3. Premature infants
4. Pyloric stenosis
5. Non-accidental injury

Further resources

www.videoplatform.aagbi.org

- Heart-Racing Paediatric Anaesthetic Emergencies
- Revalidation in Paediatric Anaesthesia for the Non-Specialist
- APA Paediatic Difficult Airways Guidelines
- Challenges in Paediatric Anaesthesia: Difficult Airways & Circulations
- Paediatric Sedation
- Transporting the Head Injured Child
- The Uncooperative Child
- The NCEPOD Review of Organisational and Clinical Aspects of Surgery In Children

alysoncalder@doctors.org.uk, GAT April 2013

APA

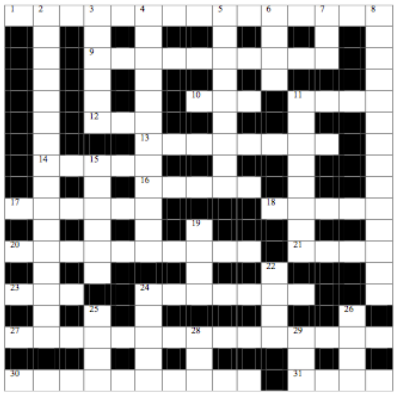
Further resources

www.apagbi.org.uk

Trainee Section

- Past exam questions
- Study resources
- Anaesthetic puzzles
- Virtual patients
- 9 page .pdf handout
- Details of courses/ meetings

APA TRAINEE CROSSWORD January 2013



Across

1 Electrical activity following stimulation. Can be used to monitor depth of anaesthesia. (6, 9)
9 Index derived from the EEG (10)
10 Malignant disease with peak incidence between 2-5y (1,1,1)
11 ___ of Galen (4)
12 When this rise, Cushing's reflex may be elicited (1,1,1)
13 Procedure originally for correction of Transposition of the Great Arteries (8)
14 Two of these emit wavelengths of 660nm and 980nm in pulse oximeters (5)
16 Cast used to maintain hip position following femoral osteotomy (5)
17 May be found nasally in children with cystic fibrosis (6)
18 Chest segment which doesn't move outwards with inspiration (5)
20 Means by which mitochondrial DNA is inherited (9)
21 The type of DC shock used in cardioversion (abbrev.) (4)
23 Risk of infection in this disease can be monitored using the CD4 count (1,1,1)
24 Lola's older brother (7)
27 One of the nerves blocked for hernia surgery (15)
30 Haemoglobinopathy (6, 4)
31 American high school drama starring New Directions (4)

Down

2 Syndrome associated with cleft palate, hypotonia, slender fingers, long face and micrognathia (16)
3 Syndrome associated with a particular facial appearance resembling make-up used in Japanese theatre (6)
4 Increases factor VIII and von Willebrand factor levels (12)
5 Drug which suppresses uterine contractions (9)
6 Monitoring technique gaining popularity, particularly in neonates (1,1,1,1)
7 Sick (3)
8 Commonest cause of stridor in infants (14)
11 Occurs in neonates secondary to malrotation (8)
15 Diatomic gas (6)
19 Forearm bone (4)
22 In research, observer blinding aims to reduce this (4)
24 Milky fatty fluid taken up by lacteals (5)
25 Big ___, Little ___ (4)
26 ___ the Knight (4)
28 ___ Direction (3)
29 When observed in the trachea, can signify respiratory distress (3)

FOR THE ANSWERS, GO TO 'PROCRASTINATION CORNER' ON THE TRAINEE SECTION AT www.apagbi.org.uk

Final FRCA Written
PAEDIATRICS Past Paper Questions
(November 1996- October 2012)

Sept 2012

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%)

March 2012
No question

Sept 2011

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?

March 2011

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%)

Sept 2010

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.

alysoncalder@doctors.org.uk, GAT April 2013