Paediatric Emergency Department Call (or Calls on a Bad Day)

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ST6 Anaesthetics
UHCW

Introduction

- In 2006, the UK Department of Health (DoH) published *The acutely or critically sick or injured child in the District General Hospital: A team response*

- Recognition that care of sick children can be challenging for the anaesthetist who is only involved in the occasional care of paediatric patients

Case 1

- “Paediatric medical alert, A&E Resus, ETA 15 minutes”

- Further history available from Paramedics en route:
  - 6 year old male child
  - Sudden onset dyspnoea and wheeze at 13:00 in playground at school
  - Known asthmatic
  - RR – 34, SaO2 – 94% (100% O2), HR – 130, BP – 100/56
  - Salbutamol nebuliser given

Management of acute asthma in children in hospital

Age 2-5 years

ASSESS ASTHMA SEVERITY

Moderate asthma

- SpO_2 ≥92%
- No clinical features of severe asthma

NB: If a patient has signs and symptoms across categories, always treat according to their most severe features

Severe asthma

- SpO_2 <92%
- Too breathless to talk or eat
- Heart rate >140/min
- Respiratory rate >40/min
- Use of accessory neck muscles

Life-threatening asthma

SpO_2 <92% plus any of:

- Silent chest
- Poor respiratory effort
- Agitation
- Altered consciousness
- Cyanosis

Oxygen via face mask/nasal prongs to achieve SpO_2 94-98%

Age >5 years

ASSESS ASTHMA SEVERITY

Moderate asthma

- SpO_2 ≥92%
- PEF >50% best or predicted
- No clinical features of severe asthma

NB: If a patient has signs and symptoms across categories, always treat according to their most severe features

Severe asthma

- SpO_2 <92%
- PEF 33-50% best or predicted
- Heart rate >125/min
- Respiratory rate >30/min
- Use of accessory neck muscles

Life-threatening asthma

SpO_2 <92% plus any of:

- PEF <33% best or predicted
- Silent chest
- Poor respiratory effort
- Altered consciousness
- Cyanosis

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On Arrival to ED

- ED Arrival – 13:30
- Focused History – AMPLE
  - Allergies: “Hayfever, unable to take NSAIDs”
  - Medications: “Inhaler”
  - PMH: Asthma – one previous hospital admission (HDU), vaccinations – UTD
  - Last ate – 12:00
- Examination
  - A: Patent, self-maintained
  - B: RR – 45/min, SaO2 – 91% (100% O2), accessory muscle use, intercostal recessions, quiet breath sounds, PvO2 – 6.3
  - C: HR – 140, BP – 94/46, IV access obtained R ACF
  - D: GCS – 12/15 (E3V4M5), PERLA
  - E: Temp – 37.4

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Oxygen via face mask/nasal prongs to achieve SpO_2 94-98%

- β_2 agonist 2-10 puffs via spacer ± facemask (given one puff at a time inhaled separately using tidal breathing)
- Give one puff of β_2 agonist every 30-60 seconds up to 10 puffs according to response
- Consider soluble oral prednisolone 20 mg

Reassess within 1 hour

- β_2 agonist 10 puffs via spacer ± facemask or nebulised salbutamol 2.5 mg
- Soluble prednisolone 20 mg or IV hydrocortisone 4 mg/kg
- Repeat β_2 agonist up to every 20-30 minutes according to response
- **If poor response** add 0.25 mg nebulised ipratropium bromide

- Nebulised β_2 agonist: salbutamol 2.5 mg **plus** ipratropium bromide 0.25 mg nebulised
- Oral prednisolone 20mg or IV hydrocortisone 4mg/kg if vomiting
- Consider adding 150 mg $MgSo_4$ to each β_2 agonist/ipratropium nebuliser in first hour

Discuss with senior clinician, PICU team or paediatrician

- Repeat bronchodilators every 20-30 minutes

ASSESS RESPONSE TO TREATMENT
Record respiratory rate, heart rate and oxygen saturation every 1-4 hours

- β_2 agonist 2-10 puffs via spacer and mouthpiece (given one puff at a time inhaled separately using tidal breathing)
- Give one puff of β_2 agonist every 30-60 seconds up to 10 puffs according to response
- Oral prednisolone 30-40 mg

Reassess within 1 hour

- β_2 agonist 10 puffs via spacer or nebulised salbutamol 5 mg
- Oral prednisolone 30-40 mg or IV hydrocortisone 4 mg/kg if vomiting
- **If poor response** nebulised ipratropium bromide 0.25 mg
- Repeat β_2 agonist and ipratropium up to every 20-30 minutes according to response

- Nebulised β_2 agonist: salbutamol 5 mg **plus** ipratropium bromide 0.25 mg nebulised
- Oral prednisolone 30-40 mg or IV hydrocortisone 4mg/kg if vomiting
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Discuss with senior clinician, PICU team or paediatrician

- Repeat bronchodilators every 20-30 minutes

ASSESS RESPONSE TO TREATMENT
Record respiratory rate, heart rate, oxygen saturation and PEF/FEV every 1-4 hours

RESPONDING

- Continue bronchodilators 1-4 hours as necessary
- Discharge when stable on 4-hourly treatment
- Continue oral prednisolone for up to 3 days

At discharge

- Ensure stable on 4-hourly inhaled treatment
- Review the need for regular treatment and the use of inhaled steroids
- Review inhaler technique
- Provide a written asthma action plan for treating future attacks
- Arrange follow up according to local policy

NOT RESPONDING

- **Arrange HDU/PICU transfer**

Consider:

- **Chest X-ray and blood gases**
- **IV salbutamol** 15 micrograms/kg bolus over 10 minutes **followed** by continuous infusion 1-5 micrograms/kg/min (dilute to 200 micrograms/ml)
- **Bolus IV infusion of magnesium sulphate** 40 mg/kg (max 2 g) over 20 minutes
- **IV aminophylline** 5 mg/kg loading dose over 20 minutes (omit in those receiving oral theophyllines) **followed by** continuous infusion 1 mg/kg/hour

RESPONDING

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At discharge

- Ensure stable on 4-hourly inhaled treatment
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- Provide a written asthma action plan for treating future attacks
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NOT RESPONDING

- **Continue 20-30 minute nebulisers and arrange HDU/PICU transfer**
- Consider: **Chest X-ray and blood gases**

Consider risks and benefits of:

- **Bolus IV salbutamol** 15 micrograms/kg if not already given
- Continuous **IV salbutamol infusion** 1-5 micrograms/kg/min (200 micrograms/ml solution)
- **Bolus IV infusion of magnesium sulphate** 40 mg/kg (max 2g) over 20 minutes
- **IV aminophylline** 5 mg/kg loading dose over 20 minutes (omit in those receiving oral theophyllines) **followed by** continuous infusion 1mg/kg/hour

Still not Responding to Treatment? ETT Time?

- Why Hesitate?
  - Tracheal foreign body aggravates bronchospasm
  - PPV increases risk of barotrauma and hypotension
  - >50% mortality occurs during or immediately after intubation
  - Intubation rates at peripheral hospitals are far higher than at specialist paediatric centres – may be due to less aggressive medical therapy and lack of management experience
- When Not to Hesitate
  - Cardiorespiratory arrest
  - Respiratory arrest
  - Acute severe hypoxaemia
  - Severe hypercapnia (>10 kPa) with clinical signs of life-threatening asthma (silent chest, poor respiratory effort, altered consciousness, cyanosis, SaO_2<92%)
  - Progressive clinical deterioration (increasing respiratory distress, physical exhaustion, altered mental status) refractory to medical management

How to Intubate

- Pre-oxygenate
- +/- Decompress stomach, +/- RSI / cricoid
- Aim for euvolaemia pre-induction
- Sedation: Ketamine 2 mg/kg or Propofol
- Neuromuscular blockade:
  - Avoid histamine releasing agents
  - Suxamethonium – may improve neb induced hypokalaemia, more rapid muscle relaxation
  - Rocuronium – more prolonged muscle relaxation – may avoid large swings in airway / pleural pressures
- Cuffed ETT – avoid need for ETT size changes due to leak – likely as high airway pressures often seen

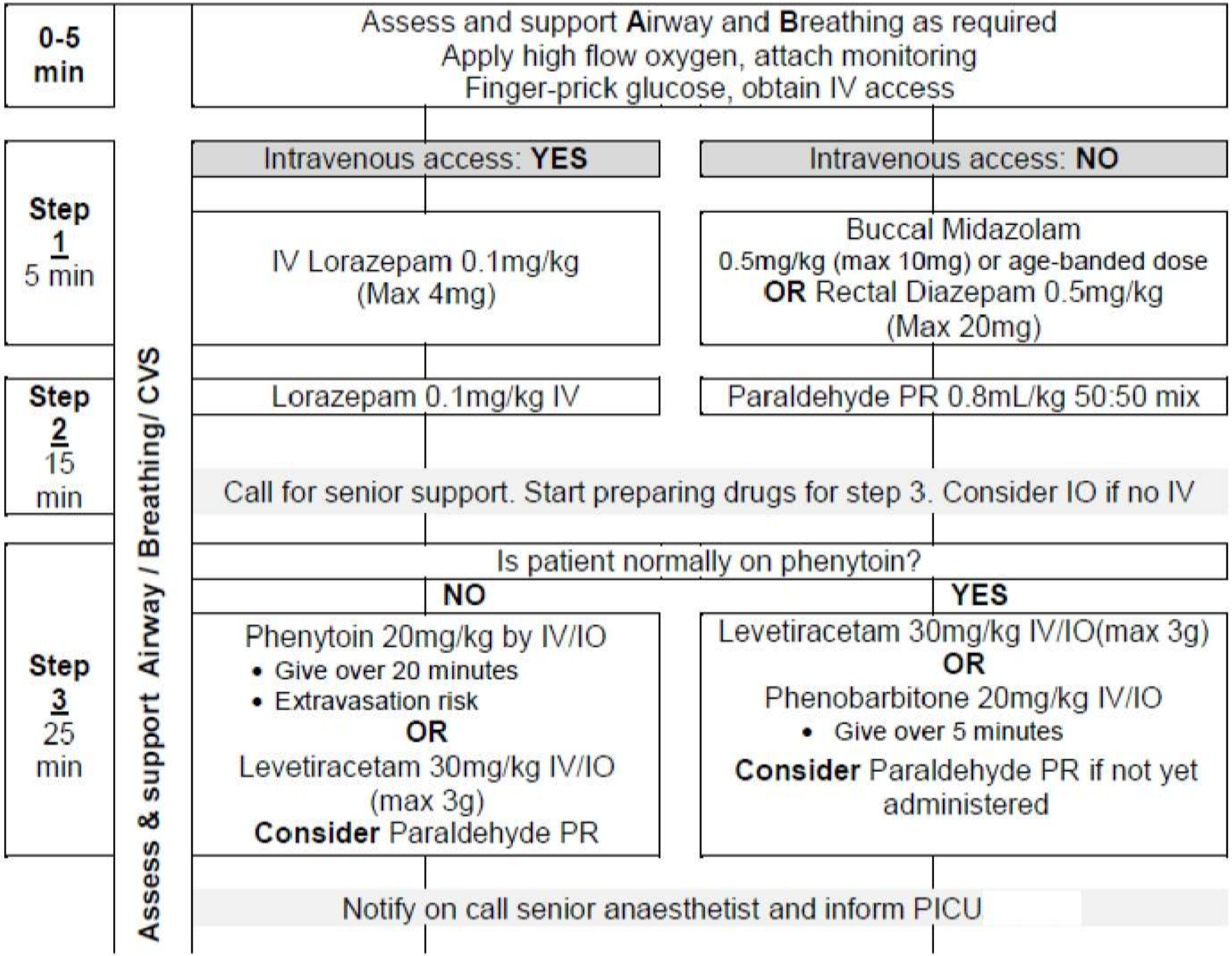
After Intubation

- Expect hypotension / circulatory disturbance
  - Volume replacement may be required (10 ml/kg) – beware over-filling may cause pulmonary oedema
  - Peri-arrest situation: 1 microgram/kg IV of Adrenaline will ameliorate hypotension and act as a bronchodilator
  - IM or SC dose of 10 mcg/kg also may be used
  - Adrenaline infusions are sometimes necessary (0.05 – 0.2 mcg/kg/min)
- Lung protective ventilation strategies:
  - Allow long expiratory time (IE ratio alteration)
  - Accept hypercapnoea / hypercarbia
  - Aim pH > 7.2
  - Limit peak inspiratory pressure (PIP) <35 cmH_2O
  - TV 6 – 8 ml/kg, low PEEP
  - Avoid over-zealous manual ventilation
- Increasing pressures: consider pneumothorax / secretion ETT obstruction
- Consider continuous provision of inhalational agents: Sevo/Iso/Halo (all bronchodilators)

Case 2:

- Paediatric SpR on-call request

- “We have a 3 year old child in A&E Resus who has been admitted with seizures and we are about to start Phenytoin. We need you come and review (please)?”


0-5 min
Assess and support Airway and Breathing as required
Apply high flow oxygen, attach monitoring
Finger-prick glucose, obtain IV access
Step 1 5 min
Intravenous access: YES
Intravenous access: NO
IV Lorazepam 0.1mg/kg (Max 4mg)
Buccal Midazolam 0.5mg/kg (max 10mg) or age-banded dose OR Rectal Diazepam 0.5mg/kg (Max 20mg)
Step 2 15 min
Lorazepam 0.1mg/kg IV
Paraldehyde PR 0.8mL/kg 50:50 mix
Call for senior support. Start preparing drugs for step 3. Consider IO if no IV
Step 3 25 min
Is patient normally on phenytoin?
NO
YES
Phenytoin 20mg/kg by IV/IO
• Give over 20 minutes
• Extravasation risk
OR
Levetiracetam 30mg/kg IV/IO (max 3g)
Consider Paraldehyde PR
Levetiracetam 30mg/kg IV/IO(max 3g)
OR
Phenobarbitone 20mg/kg IV/IO
• Give over 5 minutes
Consider Paraldehyde PR if not yet administered
Assess & support Airway / Breathing/ CVS
Notify on call senior anaesthetist and inform PICU

Further Information on Arrival

- Known epilepsy
- Vomiting for last 48 hours
- Last seizure 3 months ago
- Usual seizure frequency – one every 6 months

- Seizure ongoing for 20 minutes
- Initially treated with Midazolam (buccal) by Paramedics
- Second Midazolam dose (IV) given on arrival to ED at 15 minutes

Definition: prolonged seizure (>30 minutes) or recurrent seizures without return to baseline between seizures
All seizures lasting > 5 minutes at risk of progressing to SE. Delay in initiating therapy increases risk of refractory seizures.

Majority of seizures are terminated by end of protocol, if not this is REFRACTORY STATUS EPILEPTICUS

Causes

- Febrile convulsions and known epilepsy are most common
- Consider also:

  CNS infection, hyponatraemia, hypoglycaemia, head injury (acute or previous), cerebral vascular event (infarct or bleed), space occupying lesion, blocked VP shunt, hypoxia, ischaemia, poisoning, inborn error of metabolism

Management principles

- Maintain **A**irway, **B**reathing and **C**irculation
- Treat seizures as soon as possible per algorithm below
- Find and treat underlying cause
- Minimize systemic complications e.g. hypoxia, hyperthermia, hypotension, hypoglycaemia

Urgent investigations

- Finger prick blood glucose
- FBC, sodium, calcium, magnesium, urea, creatinine, CRP
- Ammonia if neonate/ suspect inborn error of metabolism
- Consider toxicology screen (esp. teenagers)
- Blood pressure (exclude malignant hypertension)
- CT if focal signs/ new focal seizure, trauma, possible VP shunt complication or space occupying lesion

Potential problems

- Hypoventilation post benzodiazepines – majority can be extubated as soon as awake
- Failure to recognise ongoing seizures
- Failure to identify and treat cause (e.g low Na, low glucose)

ABC and Ix

- A – patent, self-maintained in recovery position
- B – RR – 12, SaO2 – 99% (15 L O2/min)
- C – HR – 125, BP – 106/63, IV access L ACF
- D – GCS 3/15, ongoing tonic-clonic seizure activity, PERLA
- E – T 37.7, no evidence of head injury, ear / throat infection

- VBG: pO2 18.9, pCO2 6.4, pH 7.29, Lac 5.4, Glucose 7.8, Na 134, K 4.7
- Bloods (FBC, U&E, LFT, CRP, Mg, PO4 pending)

Step 4 45 min

Rapid sequence induction of anaesthesia: intubate and ventilate
Propofol 2-4mg/kg IV (unless metabolic) or thiopental 3-5mg/kg IV
Short acting muscle relaxant (not infusion)

Step 5 60 min

Reassess and consider:

- Ongoing seizures – difficult to identify if muscle relaxed (pupils, heart rate, blood pressure) → refractory SE*
- CT if focal signs, focal/atypical seizure, trauma, possible raised ICP
- Check sodium, magnesium, calcium and ammonia results
- Specific therapies as appropriate: antibiotics, aciclovir, neurosurgery, etc
- **If intubated for hypoventilation, assess for extubation**
- **Lumbar puncture should not be performed in child with reduced GCS**

***REFRACTORY SEIZURES: inform KIDS to retrieve/ PICU consultant at BCH**

- Load with Levetiracetam 30mg/kg IV (max 3 grams) over 5 minutes (if not used already)
- Aim to terminate seizures within 30 minutes with midazolam infusion
- Bolus 0.1mg/kg & start infusion at 2 micrograms/kg/minute (wait 10 minutes)
- Increase rate to **5, 10, 15, 20** micrograms/kg/minute every **5 min** until seizure stopped
- DO NOT bolus on increments as escalation rapid
- Monitor for hypotension. Avoid muscle relaxation (masks seizures)
- Re-load with ½ dose (10 mg/kg) phenytoin OR 10 mg/kg phenobarbitone
- Ongoing seizures discuss urgently with PICU consultant and Neurology Consultant

Case 3

- “Paediatric alert, A&E Resus, Anaesthetist to attend”

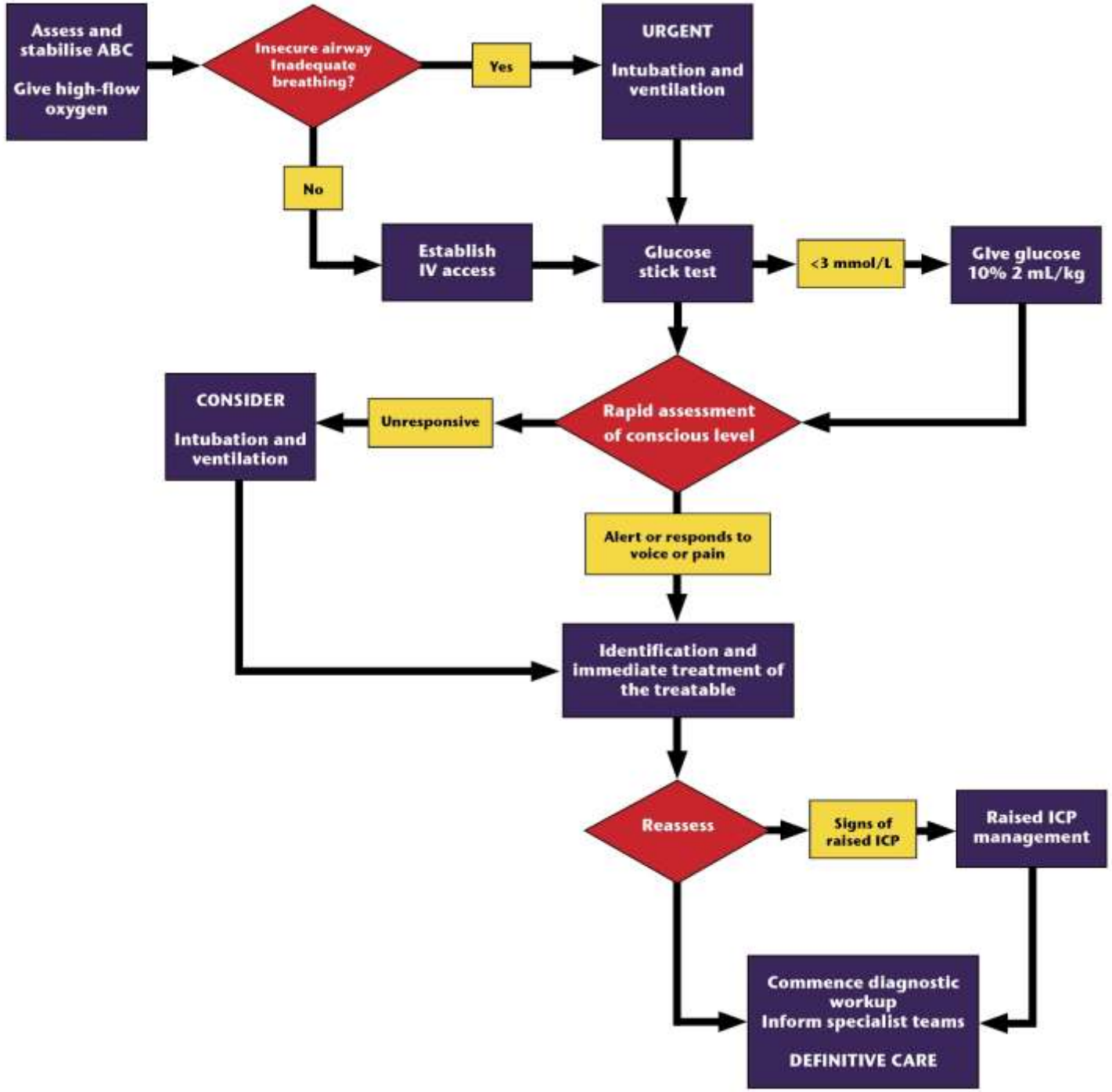
- 5 year old male
- Found unresponsive at home at 20:45

- ED arrival at 21:20
- Little history available from parents / family (only speak Romanian)
- BM 2.8 with Paramedics – given Glucagon

On Arrival to ED

- Examination
  - A: NP airway in-situ, snoring
  - B: RR – 12/min, SaO2 – 98% (100% O2), no accessory muscle use, no intercostal recessions, normal breath sounds, PvO2 – 9.6, PvCO2 – 5.5
  - C: HR – 70, BP – 99/46, IV access obtained
  - D: GCS – 7/15 (E1V2M4), PERLA, Glucose – 3.7, no head contusions / CSF leak
  - E: Temp – 35.4

- Investigations
  - pH – 7.26, BE = -6.8, HCO3 – 17.2, Lactate – 3.7, Na – 139, K – 3.3, Cr – 74
  - Urinary ketones – 3+


Assess and stabilise ABC
Give high-flow oxygen
Insecure airway Inadequate breathing?
Yes
URGENT
Intubation and ventilation
No
Establish IV access
Glucose stick test
<3 mmol/L
Give glucose 10% 2 mL/kg
Rapid assessment of conscious level
Unresponsive
CONSIDER
Intubation and ventilation
Alert or responds to voice or pain
Identification and immediate treatment of the treatable
Reassess
Signs of raised ICP
Raised ICP management
Commence diagnostic workup
Inform specialist teams
DEFINITIVE CARE

Clinical Assessment of ICP

Signs of raised intracranial pressure:

- Pailloedema
- Bulging fontanelle
- Abnormal oculocephalic reflexes (avoid in patients with neck injuries):
  - When the head is turned to the left or right a normal response is for the eyes to move away from the head movement; an abnormal response is no (or random) movement
  - When the head is flexed, a normal response is deviation of the eyes upward; a loss of conjugate upward gaze is a sign suggestive of raised ICP
- Abnormal posture
  - Decorticate (flexed arms, extended legs)
  - Decerebrate (extended arms, extended legs)
  - Posturing may need to be elicited by a painful stimulus
- Abnormal pupillary responses: unilateral or bilateral dilatation suggests raised ICP

- None present in our case

Diagnostic Work Up

- Idiopathic / Iatrogenic
- Vascular: (CVA / haemorrhage / thrombus)
- Inflammatory
- Trauma (SAH / SDH / EDH / ICH)
- Autoimmune
- Metabolic (renal / hepatic / Na / glucose / temp / toxins)
- Infective (encephalitis / meningitis / abscess)
- Neoplastic
- Degenerative

Diagnostic Work Up: History

- Romanian translator requested:

- Parents found collapsed in basement
- Lifted into living room before paramedics arrival
- Basement contained an (illegal) alcohol distillery

- Likely that child accessed basement and ingested 100% alcohol

- Blood alcohol levels sent = 405 mg/dl (UK driving limit = 80)

Metabolic Effects of Ethanol

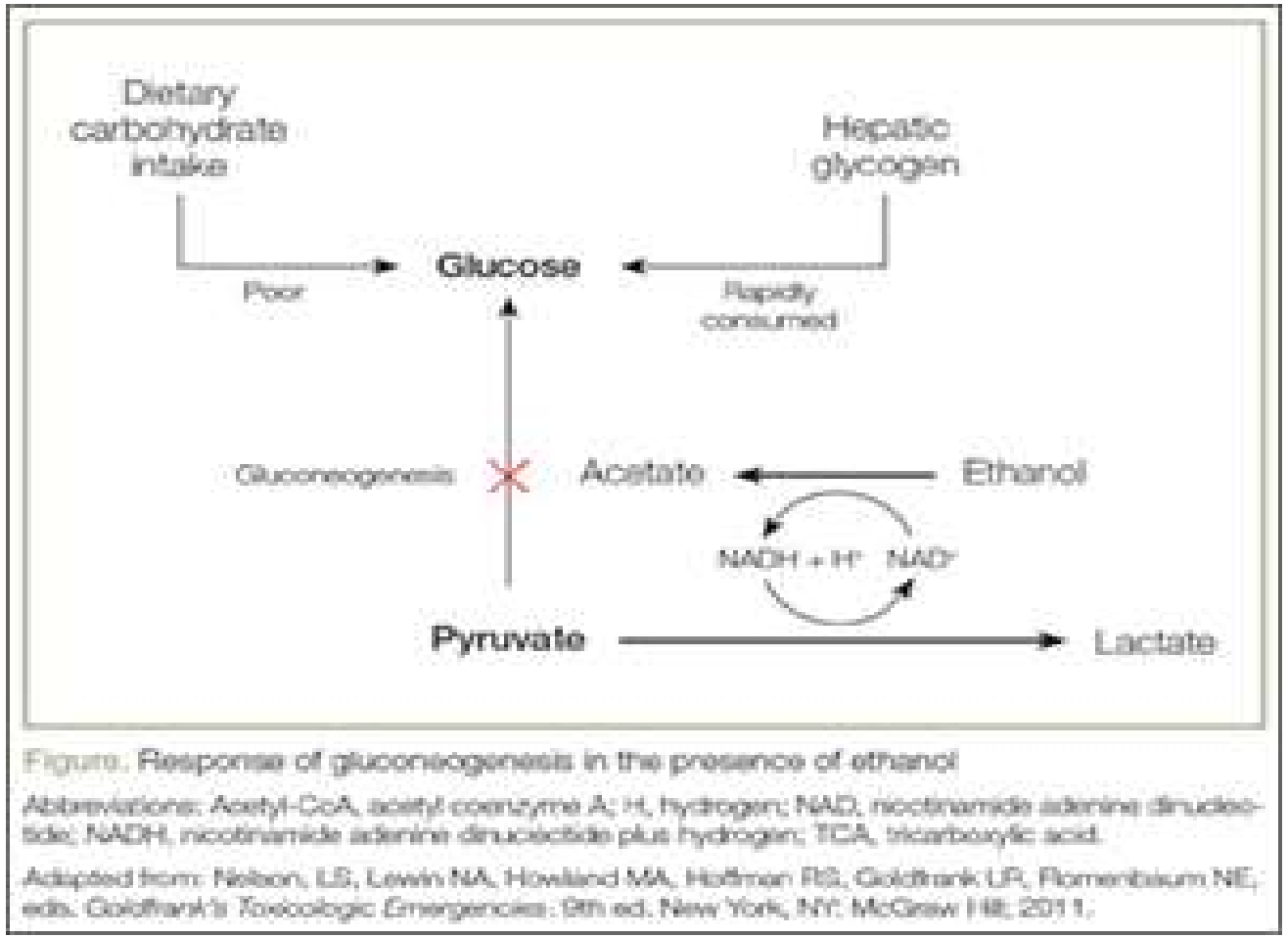


Figure. Response of gluconeogenesis in the presence of ethanol

Abbreviations: Acetyl-CoA, acetyl coenzyme A; H, hydrogen; NAD, nicotinamide adenine dinucleotide; NADH, nicotinamide adenine dinucleotide plus hydrogen; TCA, tricarboxylic acid.

Adapted from: Nelson, LS, Lewin NA, Howland MA, Hoffman RS, Goldfrank LR, Flomenbaum NE, eds. *Goldfrank's Toxicologic Emergencies*. 9th ed. New York, NY: McGraw Hill; 2011.

Treatment

- Transfer to BCH for level 3 care

- 1.5 background rate 5% Glucose + 0.9% NaCl
- 23 kg = 40+20+3 = 63 x 1.5 = 95 ml/hr

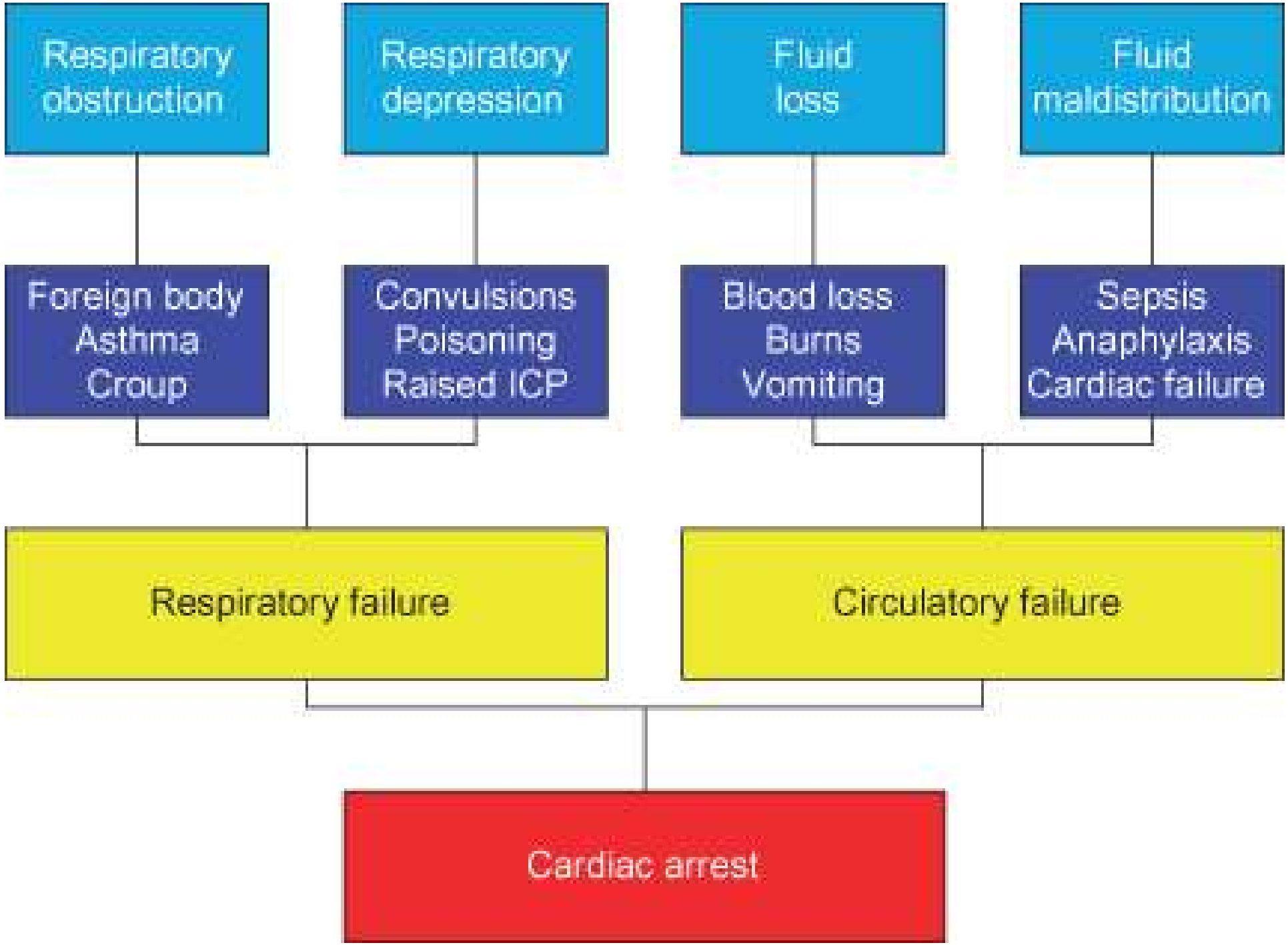
- Paracetamol 15 mg/kg QDS

- Safeguarding

Summary

- DoH – Six key, generic skills are expected of all child health professionals:
    1. To recognise the critically sick or injured child
    2. To initiate appropriate immediate treatment
    3. To work as part of a team
    4. To maintain and enhance skills
    5. To be aware of issues around safeguarding children
    6. To communicate effectively with children and carers

- APLS
    - The outcome for children following cardiac arrest is generally poor
    - Earlier recognition and management of potential respiratory, circulatory or central neurological failure will reduce mortality and secondary morbidity


Respiratory obstruction
Respiratory depression
Fluid loss
Fluid maldistribution
Foreign body
Asthma
Croup
Convulsions
Poisoning
Raised ICP
Blood loss
Burns
Vomiting
Sepsis
Anaphylaxis
Cardiac failure
Respiratory failure
Circulatory failure
Cardiac arrest