

ANALGESIA AND PROCEDURAL SEDATION

Facilitators Guide

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Duration **Up to 2 hrs**

Facilitator level **Senior trainee and above**

Learner level **Junior trainee/Staff Nurse and Senior trainee/ ANP**

Equipment Required **None**

OUTLINE

- Pre-reading
- Basics
- Pain and analgesia: 2 short cases
- Procedural sedation: 2 advanced cases
- Sim scenario
- Quiz
- Infographic sharing: 5 take home learning points

PRE-READING

Reading, watching or listening to these resources will help with a basic understanding of the topic before the session.

Pain and analgesia: PEM playbook

Procedural sedation: OpenPediatrics

RCEMLearning: Ketamine Sedation in Children

BASICS: (10 MINUTES)

(FROM PEM PLAYBOOK)

PAIN AND ANALGESIA

Children's pain is often under-treated and delays occur in receiving treatment due to many factors. These include fear of over medicating and our poor understanding of the extent of pain they are in.

Pain can be divided into two groups, nociceptive and neuropathic. Nociceptive arises from painful stimuli and follows a specific sequence; from transduction to transmission to perception and finally modulation. Neuropathic pain arises from damage to the somatosensory nervous system and is a dysregulated process. Treatments for nociceptive pain will target different parts of the pathway. Splints, local anaesthetics and elevation will reduce pain transduction. Pharmacological analgesics may help with pain transmission. Non-pharmacological methods such as distraction and reframing can help with pain perception and they all add up to encourage pain modulation. Use the developmental stage of the child to guide treatment options, especially related to non-pharmacological techniques.

- ▮ Sensorimotor stage (0-2years)
- ▮ Use the 5 senses and movement
- ▮ Engage senses as a form of distraction
- ▮ Preoperational stage (2-7 years)
- ▮ Use language (magical thinking)
- ▮ Add descriptions to distractions and use simple games
- ▮ Concrete operational stage (7- early adolescence)
- ▮ Can use straight forward logic
- ▮ More complicated games, guided imagery and participation in procedure
- ▮ Operational stage (early adolescence to adult)
- ▮ Capable of abstract thinking
- ▮ Video games, music, meditation and muscle relaxation

For pharmacological methods, aggressive and multimodal approaches are best to ensure timely and adequate analgesia.

PROCEDURAL SEDATION

Procedural sedation is indicated for children who need a potentially painful or distressing procedure during their time in the emergency department. It is not for children who have an immediate need for general anaesthesia.

PAIN AND ANALGESIA: BASIC CASES (2X10 MINUTES)

CASE 1: PAIN ASSESSMENT AND THE ANALGESIC LADDER

Lily, 4 years old presents to the ED with her mother after falling from a scooter whilst in the park. She is holding her arm and not using it. There is no obvious gross deformity.

How would you do a pain assessment in this age category?

What would be the optimum analgesia choice based on a severe pain score?

What other methods or non-pharmacological adjuncts can be used?

When should we reassess the pain?

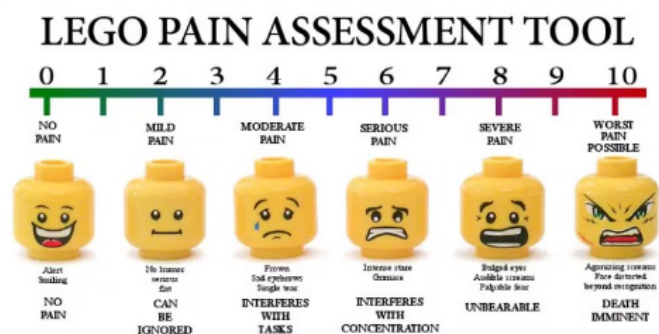
(From: RCEM guidelines: Pain management in children)

PAIN ASSESSMENT:

The RCEM guidance on pain management in children simplifies the pain score assessment as below.

Assessment of acute pain in children in the Emergency Department

Degree of pain (Numerical score)	No Pain (0)	Mild Pain (1)	Moderate Pain (2)	Severe Pain (3)
Faces Scale Score				
Behaviour	<ul style="list-style-type: none"> * Normal Activity * No ↓ movement * Happy 	<ul style="list-style-type: none"> * Rubbing affected area * Decreased movement * Neutral expression * Able to play/talk normally 	<ul style="list-style-type: none"> * Protective of affected area * ↓ movement/quiet * Complaining of pain * Consolable crying * Grimaces when affected part moved/touched 	<ul style="list-style-type: none"> * No movement or defensive of affected part * Looking frightened * Very quiet * Restless/unsettled * Complaining of lots of pain * Inconsolable crying
Injury Example	Bump on head	Abrasion Small laceration Sprain ankle/knee # fingers/clavicle Sore throat	Small burn/scald Finger tip injury # forearm/elbow/ankle Appendicitis	Large Burn # Long bone/ dislocation Appendicitis Sickle crisis
Category chosen (tick)				



Created by Brendan Powell Smith. www.TheSnarkTestament.com. This chart is not sponsored, authorized, or endorsed by the LEGO Group.

However different pain assessment tools can be used as below

1. FLACC (FACE, LEGS, ACTIVITY, CRY AND CONSOLABILITY)

- For children 2 months and over
- Behaviour assessment tool
- For children unable to report their pain
- Scored out of 10
- 0 = no pain
- 1-3 = mild pain
- 4-6 = moderate pain
- 7-10 = severe pain

Category	Score		
	0	1	2
F ace	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
L egs	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
A ctivity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
C ry	No cry (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
C onsolability	Content, relaxed	Reassured by occasional touching, hugging or being talked to distractible	

2. WONG BAKER FACES

- Self reporting tool
- Child points to the face that best represents their pain
- For children aged 3 and over
- Easily understood

Wong-Baker FACES® Pain Rating Scale



3. VISUAL ANALOGUE SCALE VAS

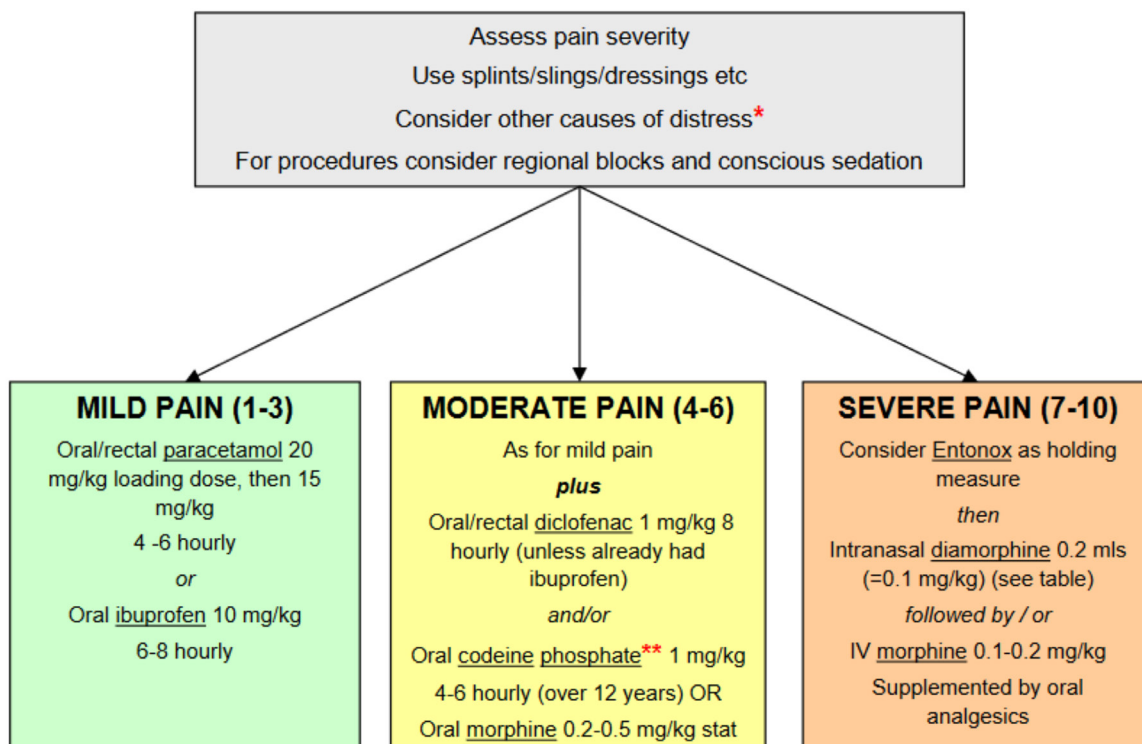
- Self reporting tool
- Needs cognitive ability to translate their pain to numbers
- For aged 7 and over

VISUAL ANALOGUE SCALE										
0	1	2	3	4	5	6	7	8	9	10
NOPAIN		Annoying (mild)		Uncomfortable (moderate)		Horrible (severe)		W O R S T		

ANALGESIC LADDER

RCEM guidelines again simplify the analgesic ladder for acute pain below;

Algorithm for treatment of acute pain in children in the Emergency Department



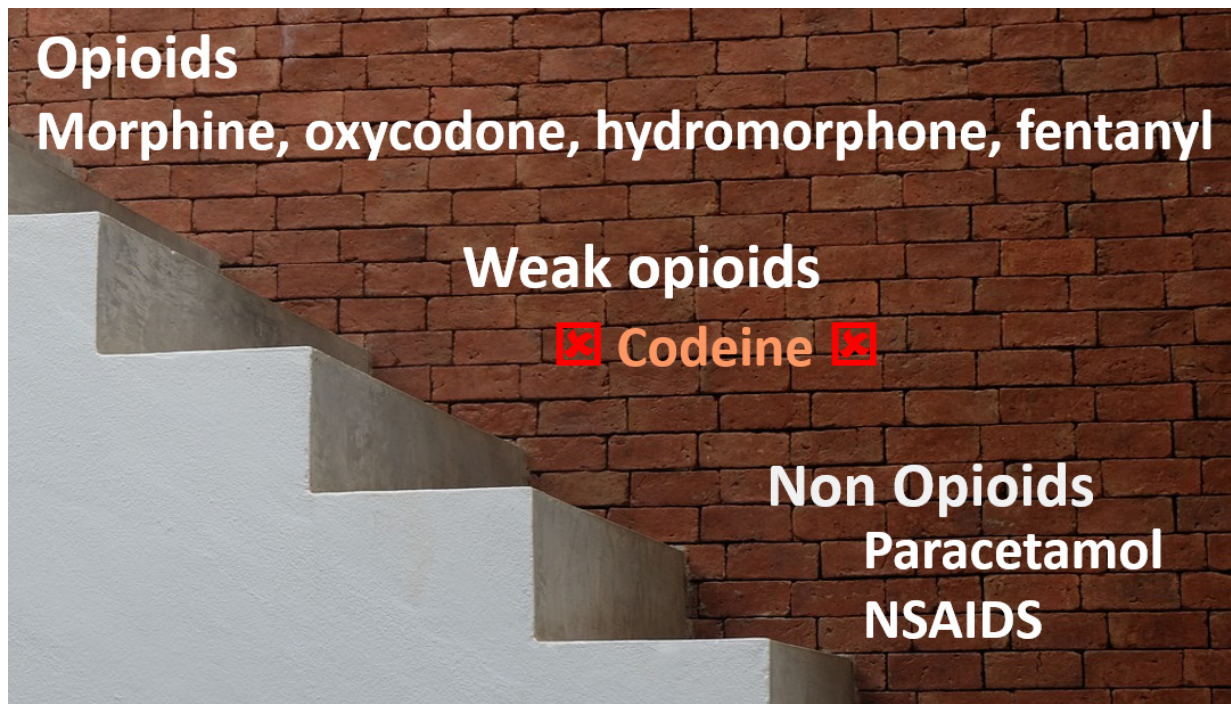
*Other causes of distress include: fear of the unfamiliar environment, parental distress, fear of strangers, needle phobia, fear of injury severity etc.

** The MHRA has restricted use of codeine to those over 12 years of age ⁽¹⁰⁾

Most children can and are able to use entonox, remember this may be a valuable source of analgesia whilst waiting for oral analgesia to work.

Different NHS trusts and hospitals may use different types of intranasal opioids so always check your individual trust formulary.

WHO PAIN LADDER



- Adjuvants should be considered in all steps of the ladder.
- Bottom of the ladder is the most commonly used paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs). Paracetamol is an antipyretic and weak analgesic. It is used for the treatment of mild pain and fever. We should avoid oligo-analgesia and use the right drug for the right kind of pain.
- Moving up the ladder are weak opioids like codeine.
- Codeine (an inactive compound of morphine) is no longer recommended for the management of acute moderate pain, particularly in children under 12 years with obstructive sleep apnoea or for post tonsillectomy procedures. Codeine must be metabolised by the cytochrome P450 enzyme 2D6 to the active compound, morphine, to relieve pain. Poor metabolizers of codeine may metabolise only up to 15% of the morphine concentration receiving little or no analgesia from codeine. Ultra rapid metabolizers may make up to 50% more morphine than normal metabolizers – which is potentially life threatening.
- Children with moderate to severe pain should receive opioids together with non opioids. Morphine, oxycodone, hydromorphone are all active compounds that do not require the enzyme conversion to provide analgesia. Fentanyl, a synthetic opioid, has few, if any cardiovascular side effects. This is in contrast to morphine which may exacerbate hypotension with its vasodilatory effects.

WHAT ABOUT INTRANASAL (IN) FENTANYL? (1.5MCG/KG)

It's easy to use, it's needle-less, and decreases the overall need for utilisation of IV or IM routes which is a positive change in parent and patient satisfaction. It bypasses first pass metabolism permitting rapid and predictable bioavailability (compared with oral and intramuscular routes) and offers direct CSF delivery via the nose- brain pathway route.

The maximum volume of IN medication permitted is 1ml per nostril and in cases of nasal trauma or septal defects, IN Fentanyl of course cannot be used. Rule of thumb, the IN dose is 2-3 times the IV dose. Administer intranasal medications in the sniffing position. Lie the patient flat with occiput posterior, put patient in the sniffing position, seat the mucosal atomizing device cushion in the nostril, aim toward the pinna of the ear, and shoot fast – you have to push the drug as fast as you can to atomize the solution.

A 2014 Cochrane review on intranasal fentanyl concluded that it can be an effective analgesic for children aged 3 years and above with acute moderate to severe pain. Studies have demonstrated IN Fentanyl to result in decreased time to medication administration and equivalent pain control when compared to IV morphine, oral morphine or IV Fentanyl. IN Fentanyl has become an excellent alternative to morphine in the ED, it has a greater safety profile and is easily available in the ED.

WHAT ABOUT INTRANASAL KETAMINE (1MG/KG)

How does it compare to IN Fentanyl? One study demonstrated a similar pain reduction in children with moderate to severe pain from an isolated limb injury in the Paediatric ED. Although the sample size was small and there was no comparator or placebo group. Adverse effects were more frequent with ketamine; however, these were all relatively mild (drowsiness and dizziness). Also, practically speaking, pain control doses for the IN Ketamine route at 1mg/kg mean that volumes for most children weighing above 10kg will exceed 1ml per naris if the ketamine concentration 10mg/ml is used.

WHAT ABOUT INTRANASAL DEXMEDETOMIDINE? (2.5MCG/KG)

An alpha-2 receptor agonist (like clonidine), does not markedly decrease blood pressure. Dexmedetomidine targets receptors in the CNS and spinal cord, and so it provides deep sedation, with very minimal blood pressure effects. It induces a sleep-like state. In fact, EEGs done under dex show the same pattern as seen in stage II sleep. IN Dexmedetomidine is safe, if titrated, and does not depress airway reflexes or respiration. The downside is that it can last 30 minutes or more, but it may be a good choice for an abdominal ultrasound or CT head.

Inflicting Pain with an IV to relieve pain is not something that makes sense to young children. IN medication offers pain relief prior to getting intravenous access and can even obviate the need for IV access if definitive care such as a cast, suturing, reduction of bony injuries can be done during the duration of action of the IN medication.

NON-PHARMACOLOGICAL ADJUNCTS:

It is important these are thought about in conjunction with pharmacological techniques. These include:

- Play specialists
- Distraction techniques
- Music
- Games
- Don't forget the Bubbles
- Immobilisation of injuries
- Environment
- Right people
- Right place
- Right time
- Parental/carer anxiety

Neonates and those under 1 year of age

Sucrose, Non-nutritive sucking interventions exert analgesic effects independent of the opioid pathway. Swaddling/facilitated tucking (preterm) and skin to skin care significantly increase B-endorphin levels, Rocking/holding neonates and breastfeeding during minor procedures have all been shown to decrease objective measures of pain such as heart rate and crying.

PAIN REASSESSMENT

Pain should be assessed on arrival and then monitored throughout their time in the emergency department and if appropriate beyond. Children in moderate and severe pain should have their pain reassessed within 60 minutes of receiving analgesia.

CASE 2: OTHER ANALGESIC CONSIDERATIONS

Frank, 8-years-old was playing in the street with friends and fell over. He cut his knee on some broken glass and sustained a 4 cm laceration over his patella. An x-ray shows no foreign body and no fractures. The knee is swollen and the laceration requires suturing. On pain assessment he is reporting mild pain.

What are your initial considerations?

What are the options for cleaning and closing?

Don't forget oral analgesics (as above) and a full assessment for other injuries.

(From DFTB: Wound management)

NON-PHARMACOLOGICAL ADJUNCTS:

LAT GEL (lidocaine adrenaline and tetracaine)

- Unsuitable for under 1's
- Takes 20-30 minutes to work
- Skin will blanch when ready
- **Max dose**
- 2mls for 1 -3 years
- 3mls for >3 years
- **Not for use on:**
- Mucous membranes
- Extremities
- Wounds > 8 hours old
- **Can be used in conjunction with local anaesthetic infiltration**
- Max dose not to exceed 5mg/kg

Local anaesthetic infiltration (lidocaine)

- Inject slowly to reduce pain
- Small gauge needle to reduce pain
- Doses
- 3mg/kg lidocaine

Other topical agents (not for this case specifically):

EMLA cream (lidocaine 2.5% and prilocaine 2.5%) is effective at numbing the tissue below intact skin to a depth of 6-7mm if left on for 30-60min but does cause vasoconstriction which can be problematic if looking to cannulate

LMX4, a topical liposomal 4% lidocaine cream like EMLA has full effectiveness by 30minutes.

Environment

- Play specialists
- Distraction techniques appropriate to age
- Preparation of the child and area
- Quiet setting
- Parental/carer involvement
- Using appropriate language

PROCEDURAL SEDATION: ADVANCED CASES (2X20 MINUTES)

CASE 1: ENTONOX SEDATION + DISCUSSION OF ADJUNCTS

Freddie, 9-years-old attends the emergency department after falling from the monkey bars. He has sustained a displaced and angulated supracondylar fracture. He has some tingling at the fingers in the ulna distribution and therefore requires urgent manipulation.

You decide to use nitrous oxide.

Do you need any pharmacological adjuncts?

What about non pharmacological?

What other considerations should be made?

(From DFTB: Procedural sedation)

Nitrous oxide

Nitrous oxide provides anaesthesia, anxiolysis and some mild amnesia but offers

limited analgesia. Administration of analgesic supplements is recommended. Many papers including the FAN study demonstrate the safety and efficacy of co-administering intranasal fentanyl. Other analgesics can also be safely used. There are 2 methods of delivering nitrous oxide, piped nitrous oxide and Entonox. Piped nitrous oxide can provide variable concentrations and can be titrated to response whereas entonox is a fixed 50/50 mix of nitrous and oxygen and comes in canisters. The canister is set up with a demand valve that needs to be overcome with a deep breath; this can be difficult for under 5's.

You should see onset of effect in 30-60 seconds with the peak effect at 2-5 minutes. Offset of effects is similar at 2-5minutes, 100% oxygen should be applied during this time post procedure to avoid diffusion hypoxia.

Side effects are minor and transient but include:

- Nausea
- Vomiting (6-10% children receiving 50% dose)
- Increases incidence with higher dose, longer duration and concurrent opioid use
- Consider prophylactic antiemetic if child has history of nausea or vomiting
- Dizziness
- Nightmares

Contraindications:

Nitrous oxide diffuses through tissues more rapidly than nitrogen alone and can expand in air containing spaces within the body, so it is contraindicated in:

- Pneumothorax
- Pneumocephalus
- After diving
- Gastrointestinal obstruction

Nitrous oxide inactivates the vitamin B12 dependent enzyme, methionine synthase and can deplete the B12 stores. Therefore caution is advised in those at risk of vitamin B12 deficiency (vegetarians, patients with gastrointestinal disorders and those taking regular H2 receptors and proton pump inhibitors)

Monitoring and staffing

Despite the absence of use of intravenous sedative drugs, it is best practice to manage this patient in a high dependency setting, with monitoring including; respiratory rate, heart rate and oxygen saturations and at least 2 members of staff where one's job is entirely focused on the sedation and monitoring of the child.

Guided imagery

Guided imagery would work well in this setting with a trained practitioner. This is a process where a variety of techniques can be used such as simple visualisation, story telling, direct suggestion imagery and fantasy exploration to elicit a physical response such as a reduction in pain, stress or anxiety.

CASE 2: KETAMINE SEDATION + DISCUSSION OF COMPLICATIONS

Lola, 2-years-old has fallen in the playground and sustained a laceration to the forehead. Lola had an ice cream after the incident in an attempt to settle her. She has no past medical history and was born at term.

Can she have procedural sedation in the department?

What are the considerations?

What drugs do you need for the sedation?

Should you use any adjuncts with the ketamine?

Are there any emergency drugs you should have available?

There are no contraindications and you decide to go ahead with ketamine sedation, during the procedure whilst full monitoring in place the CO2 trace is lost. What is your structured approach to management of this scenario?

(From RCEM guidelines: Ketamine sedation & DFTB procedural sedation)

Pre-procedure planning

A thorough pre sedation assessment is required to assess ASA grade, examine airway anatomy and illicit any contraindications listed below:

contraindications

- age < 12 months
- active asthma
- abnormal airway anatomy
- significant cardiac disease
- procedure in mouth/oropharynx
- recent head injury with reduced GCS
- active upper/lower respiratory tract infection
- severe cognitive/motor delay or developmental problems
- intracranial hypertension with CSF obstruction
- intraocular pathology
- uncontrolled epilepsy
- porphyria
- thyroid disease
- known psychosis
- prior reaction to ketamine
- expected length of procedure > 20 minutes
- drug or alcohol intoxication



Fasting:

Multiple studies have shown that fasting does not reduce the risk of aspiration or increase the risk of adverse events and the 2020 updated guidelines for ketamine sedation in the ED have echoed this. They advised that the fasting state should be considered in relation to the urgency of the procedure, but recent food intake should not be considered a contraindication to ketamine use.

Setting:

RCEM states the procedure should be carried out in an area with immediate access to full resuscitation facilities; three practitioners should be present throughout, one for the sedation, one for the procedure and one for monitoring and assistance. The updated 2020 guidance has included capnography in the mandatory monitoring required along with heart rate, ECG, blood pressure, respiratory rate and oxygen saturations. While there is no evidence that shows that capnography reduces the incidence of adverse events, there are studies that show capnography decreased the incidence of hypoxia and respiratory events.

Pre-oxygenation:

Oxygen should be given prior to the procedure if possible and during to reduce the time to de-saturation should an adverse event occur.

Drugs:

Ketamine:

Ketamine is a NMDA receptor antagonist, it is a dissociative anaesthetic, a potent analgesic and amnesic. Ketamine induces a trance like state, often with the eyes open. It maintains the airway reflexes and maintains cardiovascular stability.

The RCEM accepted dose is 1mg/kg over 60 seconds. A rate of 60 seconds reduces the incidence of adverse events such as laryngospasm. A top up dose of 0.5mg/kg can be used if necessary. Onset is within 1 minute and will elicit a horizontal nystagmus and a loss of response to verbal stimuli. The HR, BP and RR may increase slightly. Sedation will wear off after 20 minutes and full recovery should occur by 60-120 minutes. RCEM no longer advise the use of IM ketamine as they suggest it is safer to have IV access available from the start of the procedure should an adverse event occur.

Adjuncts:

Midazolam:

A 2018 BestBets review looking at 6 studies including 2 RCTs has shown that prophylactic benzodiazepines do not significantly decrease the incidence of emergence and they in fact can increase the risk of adverse events, so they should not routinely be given prophylactically. However midazolam can be used to treat severe emergence especially in older children. (Aliquots of IV 0.05-0.1mg/kg can be given)

Atropine:

Atropine was previously used prophylactically to reduce secretions however there is no evidence to support its routine use to prevent laryngospasm or other adverse airway events and again it may increase the rate of adverse events. (Green et al)

Ondansetron:

May be appropriate for patients at high risk of vomiting due to ketamine's emetogenic properties. High-risk groups include those with previous nausea/vomiting during sedation/anaesthesia, older children, those who have received opioids or where ketamine is given intramuscularly. Caution should be used in those at risk of long QT.

Emergency drugs:

RCEM suggests key resuscitation drug dose calculations should be done prior to the procedure and these should be accessible, however no specific drugs are recommended. We suggest that WETFLAG dosing should be done along with the dose calculated for suxamethonium (1.5mg/kg for RSI).

Complications:

Complications are rare with ketamine, a recent study by Bhatt et al in 2017 (6,760 patients across 5 sites in Canada) looking at propofol, ketamine, propofol/ketamine and ketamine/fentanyl, ketamine alone recorded the lowest serious adverse events at 0.4%. Green et al (2009) showed a 1% risk of noisy breathing

requiring airway repositioning, a 0.3% risk of laryngospasm and 0.02% risk of intubation being required.

The capnography trace is there to provide early warning of potential or impending airway and respiratory adverse events.

A loss of capnography trace indicates apnoea or obstruction.

First check the equipment and monitoring is still in place then check for chest wall movement.

If the chest wall is not moving then there is central apnoea.

If there is chest wall movement there is obstruction.

Airway manoeuvres will relieve obstructive apnoea but will not relieve laryngospasm. Laryngospasm can be managed following the flow chart below.



Sim scenario (30 minutes including debriefing)

Summary of Scenario	Procedure appropriate for sedation – post procedure simple airway issues due to obesity					
Faculty Required	Operator/Voice of patient/Nurse in scenario					
Starting Vital Signs	Pulse 120	BP 105/60	O2sats 99%	RR 20	ETCO2 4.2	ECG Sinus

10-year-old boy fell from the top of the climbing frame, landed awkwardly on his left ankle. Primary survey shows no other injuries except obvious deformity of the left ankle.

To establish:

Neurovascular compromise of the foot, CRT delayed

PMH: nil

BH: term, nil complications

DH: nil

NKDA, UTD with immunisations

Last ate 2 hours prior

Candidate should:

- Check full medical history
- ASA status
- Airway assessment (loose tooth, excess body fat)
- Ensure appropriate setting (RESUS)
- Appropriate equipment and monitoring (ECG, EtCO2, Sats, HR, RR, BP, suction, tilting table, resuscitation facilities)
- Describe consent
- WETFLAG calculations plus emergency drug calculations
- Choice of appropriate drugs and dosing for sedation
- Ensure appropriate staff
- Pre-oxygenation
- Checks patient during procedure

* Post procedure end tidal CO2 trace is lost (due to obesity)

- Checks equipment
- Chest wall movement
- Simple patient positioning and airway manoeuvre opens the airway and CO2 trace returns
- Describes post procedure monitoring

Learning points:

1. Emphasis on appropriate preparation
2. Systematic approach to adverse events and when to anticipate them

QUIZ (10 MINUTES)

Question 1: (True/false)

When should you assess a child's pain and document a pain score in the emergency department when they present with an injury?

1-Wait until the child is seen by a doctor before assessing pain

4-Within 60 minutes of receiving analgesia for moderate and severe pain

2-At triage

5-When the child or the child's parents informs you they are in pain

3-Immediately after giving oral analgesia

A child's pain should be assessed on arrival in the emergency department, and should be treated appropriately in a timely manner (within 20 minutes for moderate and severe pain). Pain should also be re-evaluated within 60 minutes of receiving analgesia for moderate and severe pain. This process should be repeated for all subsequent doses of analgesia. Reviewing pain should take into account peak of onset for the analgesia given; as such oral analgesics will not work immediately.

(From: RCEM guidelines pain management in children 2017)

Question 2: (True/false)

Which of the following predict possible airway difficulties in children?

1-C-spine immobilisation

4-Mouth breathing or frequent drooling

2-Premature birth requiring NICU

5-Reduced mouth opening

3-Trisomy 21

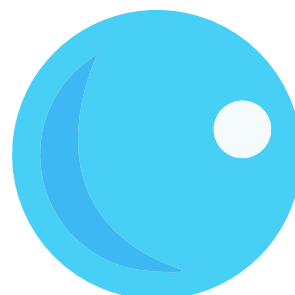
A thorough pre assessment prior to sedation should be done to elicit any potential complications and also decide on appropriateness of sedation in the emergency department.

A formal airway assessment should include:

- Mouth opening
- Assessment of dentition for loose and protruding teeth
- Tongue size
- Presence of soft tissue masses in the mouth
- Mandible size
- Neck mobility
- Temporomandibular joint mobility

A review of the child's medical history should also include, congenital abnormalities, birth complications, previous complications during anaesthetics or sedation, noisy breathing, sleep issues and concurrent upper respiratory tract infections.

(From DFTB: The needle or damage done)



Key learning points to take home (5 minutes)

- 1** Pain should be assessed at the earliest opportunity after arrival in the ED and assessed regularly.
- 2** Pain should be treated according to pain assessment.
- 3** Non-Pharmacological adjuncts should always be considered in the management of pain.
- 4** Paediatric procedural sedation should be considered for assistance with painful and distressing procedures needed within the emergency department.
- 5** Paediatric procedural sedation should only be carried out by those persons adequately trained with an awareness of the rare but critical complications in an appropriate setting.

REFERENCES

PEM playbook: paediatric pain

OpenPaediatrics: procedural sedation

RCEM guidelines: Management of pain in children, Rev 2017

RCEM guidelines: Ketamine sedation for children in emergency departments, Rev 2020

DFTB: Wound management, 2020

DFTB: All work and no play, 2017

DFTB: Procedural sedation, 2020

DFTB: Needle or damage done, 2016

EM cases: procedural sedation, 2016

St Emlyn's: Paediatric pain and sedation – tips to change your practice from EuSEM15, 2015

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