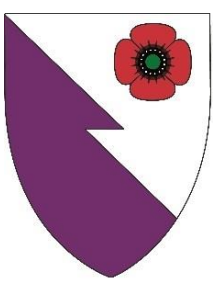
The Royal College of Emergency Medicine

Best Practice Guideline

KETAMINE PROCEDURAL SEDATION FOR CHILDREN IN THE EMERGENCY DEPARTMENT



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Summary of recommendations

1. Ketamine sedation may be appropriate for a procedure that is painful, or frightening after all other options have been considered.
2. Ketamine should not be used for sedation in the Emergency Department for children under the age of 1 year. Ketamine should be only be used by clinicians with significant relevant experience in the use of ketamine when performing procedural sedation in children aged between 2-5 years.
3. Ketamine sedation should take place in an area with full resuscitation facilities immediately available.
4. Safe sedation requires adequate senior medical and nursing cover in the Emergency Department when any sedation takes place.
5. Ketamine sedation requires a minimum of 3 dedicated members of staff, one to undertake sedation, one to monitor the patient and another to undertake the procedure.
6. Ketamine sedation should be only used by clinicians experienced in its use and capable of managing any complications, particularly airway obstruction, apnoea and laryngospasm.
7. Pre-sedation assessment should include co-morbidities, regular and acute medications, allergies, details of previous sedation and anaesthesia (including any associated problems) as well as ASA grade. This assessment should be formally documented.
8. Written consent should be obtained from the parents and young person if appropriate and written patient / parent information provided.
9. Monitoring during the procedure should include respiration, heart rate, oxygen saturation, three lead ECG, capnography, blood pressure and degree of dissociative sedation.
10. After the procedure the child should recover in a quiet, observed and monitored area under the continuous observation of a trained member of staff.
11. Departments should undertake regular audits with regards to documentation and adherence to standards as well partaking in local event reporting.

Scope

This guideline is to assist emergency physicians using intravenous ketamine as the sole agent for procedural sedation in children in the Emergency Department (ED) only. This guidance is intended to be an adjunct to existing guidance on safe procedural sedation [1,2].

Reason for development

The guidance is an update of the previous guideline [3] bringing it in line with current RCEM guideline formats and associated Best Practice Guidelines [4]. The major change in this guidance is the move away from IM ketamine to IV ketamine for procedural sedation in children. It has been recognised that whilst IV access has always been seen as a minimum standard for adults, this has not been the case for children. Whilst the use of IM ketamine is still recognised as a pragmatic option when used by a senior decision maker, clinicians should be mindful of the perceived safety benefits of having intravenous access from the start of the procedure to mitigate a rare adverse event [5]. IM ketamine has a higher risk of emesis and a longer recovery time [6]. IV access also facilitates repeat dosing for longer procedures.

Introduction

Ketamine is a unique dissociative drug introduced into clinical practice in 1970. Ketamine is a phencyclidine (PCP) derivative that acts as a dissociative sedative through binding of the N-methyl-D-aspartate (NMDA) receptor. It has anxiolytic, analgesic, amnesic and dissociative properties with a wide safety margin. It is most commonly used to facilitate short painful procedures, such as suturing or brief orthopaedic manipulations. Before ketamine procedural sedation is used all other options should be fully considered, including analgesia, reassurance, distraction, nitrous oxide/ Entonox®, intranasal diamorphine, and play therapy.

Ketamine's unique profile means the emergency physician must be aware of both the challenges and benefits of using ketamine. Probably the most challenging is the relatively common and well recognised agitation (with or without hallucinations) that can occur during the recovery period. In addition, children may experience nightmares following ketamine procedural sedation, although this is transient and will have no long lasting effects. Clinicians therefore must have experience of using ketamine for sedation in the ED, be aware of these and other potential side effects, and be in a position to confidently treat them where necessary. Parents must be made aware of possible delayed effects (in writing) and be advised to return to the ED if concerned.

Ketamine is fundamentally different from other procedural sedation agents, and does not conform to the continuum tenet. Arguably this increases its attraction for the clinician. Dissociation is either present or absent, with a narrow transition zone; this dissociated state has no observable progression or depth, therefore further dosing does not result in deeper sedation, as is the case with opioids, hypnotics and inhalation agents. With non-dissociative agents this would result in an

increased likelihood of airway and respiratory compromise. Ketamine has a wide margin of safety.

Box 1. Characteristics of ketamine sedation

- Dissociation – trance-like state with eyes open but not responding
- Catalepsy – normal or slightly increased muscle tone maintained
- Analgesia – excellent analgesia is typical
- Amnesia – usually total
- Airway reflexes maintained
- Cardiovascular state – blood pressure and heart rate increase slightly
- Nystagmus is typical, usually horizontal; eyes remain open and glazed

The doses advised for analgesic sedation are designed to leave the patient capable of protecting their airway. There is a significant risk of a failure of sedation if the procedure is prolonged, and the clinician must recognise that the option of general anaesthesia may be preferred in these circumstances. If a procedure is likely to last longer than 20 minutes then consideration ought to be given to performing this in theatres under general anaesthesia.

Box 2. Speed of action of ketamine

- Clinical onset (approximately) 1 minute
- Effective sedation 10-20 minutes
- Time to discharge (average) 90 minutes

Ketamine should be only used by clinicians experienced in its use and who are capable of managing any complications, particularly airway obstruction, apnoea and laryngospasm. The doctor managing the ketamine sedation and airway should be a suitably trained middle grade or consultant with a minimum of 6 months experience in anaesthesia or intensive care medicine and an up to date paediatric advanced life support course. Pre-sedation assessment should include co-morbidities, regular and acute medications, allergies, details of previous sedation and anaesthesia (including any associated problems) as well as ASA grade. Obesity is an independent risk factor for procedural sedation [7]. This assessment should be formally documented. Documentation of procedural sedation is fundamental to ensuring safe and auditable practice in this area as well as monitoring the standard of care provided. Appendix 1 contains an example of a pro-forma template developed for use as a checklist, for formal recording, for monitoring and for the purposes of audit. Clinical Incident or event reporting during procedural sedation should be done at a local level and may include use a reporting system such as SIVA (appendix 2) [8].

Indications

Children over 12 months of age (there is an increased risk of airway complications in children less than 12 months and especially less than 3months), however departmental and relevant clinician experience will likely dictate that the actual lower age limit in practise is likely to be 5 years.

Ketamine can be used for procedural sedation in children who will need a painful or frightening procedure during the course of their emergency care. It can be used instead of general anaesthesia for minor and moderate procedures (see box 3 for potential uses). It can be used in combination with local anaesthetic techniques. Ketamine's property of cataplexy means the patient remains relatively still removing the need for any form of physical restraint.

Ketamine sedation should not be used in children who have a clear need to go to the operating theatre.

Box 3. Examples of potential procedures where ketamine maybe employed

- Suturing
- Fracture reduction / manipulation
- Joint reduction
- Burn management
- Incision and Drainage of abscess
- Tube thoracostomy placement
- Foreign body removal
- Wound exploration / irrigation

Contraindications

In addition to general contraindications:

- Pulmonary Hypertension
- Age less than 12 months due to an increased risk of laryngospasm and airway complications
- A high risk of laryngospasm (active respiratory infection, active asthma)
- Unstable or abnormal airway. Tracheal surgery or stenosis.
- Active upper or lower respiratory tract infection
- Proposed procedure within the mouth or pharynx
- Patients with severe psychological problems such as cognitive or motor delay or severe behavioural problems
- Significant cardiac disease (angina, heart failure, malignant hypertension)
- Intracranial hypertension with CSF obstruction
- Intra-ocular pathology (glaucoma, penetrating injury)
- Previous psychotic illness
- Uncontrolled epilepsy
- Hyperthyroidism or Thyroid medication
- Porphyria
- Prior adverse reaction to ketamine

- Altered conscious level due to acute illness or injury
- Drug / alcohol intoxication

Side Effects

- Mild agitation (20%)
- Hypersalivation and lacrimation (<10%), evidence suggests co-administration of anti-cholinergic agents (e.g. atropine) are not necessary [9,10]
- Involuntary movements / ataxia (5%)
- Vomiting 5-10% of children will vomit in recovery period
- Transient rash 10%

Most of the above self-resolve and require observation only.

Potential Complications:

Historically the major concerns surrounding the use of ketamine refer to laryngospasm and emergency phenomenon

- **APNOEA** – this can occur after rapid IV bolusing of ketamine but is rare (0.3%). Airway repositioning or brief bag-valve-mask ventilation has been occasionally required. IV administration over 60 seconds eliminates this problem.

- **AIRWAY MISALIGNMENT / NOISY BREATHING** (<1%) – basic airway repositioning is usually sufficient to resolve this uncommon event. So called 'ketamine breathing', deep sighing respirations, can be misinterpreted as stridor, and again is minimised with correct head positioning.

- **LARYNGOSPASM** – rare transient event (0.3%), the reported incidence of intubation of laryngospasm is 0.02%. The risk appears higher in children who undergo stimulation of the posterior pharynx, or who have active respiratory disease (e.g. URTI); which are therefore contra-indications to ketamine procedural sedation in the ED. Again, airway and patient positioning and occasional bag-valve-mask ventilation will usually suffice.

- **EMERGENCE PHENOMENA** – ketamine is known to induce agitation and hallucinations in both adults and children as the dissociative effects wear off. In children under 10 years, it is still uncommon (1.6%), but is more common beyond mid adolescence (can affect up to 1 in 3 adults). This can be reduced by positive psychology prior to drug administration ('have a happy dream') and can be mitigated with benzodiazepines on occurrence in the recovery period, however prophylactic administration is NOT necessary.

Procedure

1. At least three dedicated staff are required for the duration of the procedure:
   - a doctor to manage the sedation and airway,
   - a clinician to perform the procedure
   - an experienced nurse to monitor and support the patient, family and clinical staff.

2. Ketamine procedural sedation should be only used by clinicians experienced in its use and capable of managing any complications, particularly airway obstruction, apnoea and laryngospasm. The procedural sedationist's competencies should reflect this.

3. The child should be managed in high dependency or resuscitation area with immediate access to full resuscitation facilities.
   - Monitoring should include sedation level, pain, ECG, blood pressure, respiration and pulse oximetry and capnography
   - Observations should be regularly taken and recorded (every 5 minutes)

4. Supplemental oxygen should be given prior to and during the procedure (recognising that on occasion the procedure (facial suturing) may prevent the use of an oxygen mask during the procedure. However, it should be recognised that there is clear evidence for the safety of using only 'room air' only during ketamine in procedural sedation [11]. Discuss the proposed procedure and use of ketamine with parent or guardian and obtain written consent.

   The known risks are:
   - mild agitation (20%)
   - moderate/severe agitation (1·5%)
   - rash (10%)
   - vomiting (7%)
   - transient clonic movements (<5%)
   - airway problems (<1%)

   It is important to emphasise to the adult providing consent that nystagmus, purposeless movements and some degree of dissociation are normal during ketamine sedation.

5. There is no evidence that complications are reduced if the child is fasted [12]. Traditional anaesthetic practice favours a period of fasting prior to any sedative procedure. The fasting state of the child should be considered in relation to the urgency of the procedure and the child's comorbidity [13] but recent food intake should not be considered as a contraindication to ketamine use.

6. Where time permits, topical anaesthesia (EMLA®, Ametop®, etc.) should be used to reduce the pain of intravenous cannulation.

7. The literature recommends a dose of ketamine of 1.0 mg/kg by slow intravenous injection over at least one minute (more rapid administration is associated with respiratory depression). Successful sedation for short procedures can be achieved with lower doses such as 0.6-0.8 mg/kg. Supplemental doses of 0.5mg/kg by slow IV injection, may be required after 5-10 minutes to achieve the required dissociative state.

8. Draw up ketamine dose. Calculate key resuscitation drugs and ensure they are readily available. Encourage the child and parents to talk (dream) about happy topics. This helps minimise unpleasant emergence phenomena. Parents should be encouraged to stay with the child until sedation is achieved and whilst the child is recovering.

9. The effects of ketamine are usually evident 1-2 minutes after administration. Painful procedures should not be initiated until 2 minutes after ketamine has been administered.

10. Adequate sedation is usually indicated by loss of response to verbal stimuli and nystagmus: heart rate, blood pressure and respiration rate may all increase slightly.

11. Lacrimation or salivation may be observed.

12. Local anaesthetic should be used where indicated.

13. After the procedure the child should recover in a quiet, observed and monitored area under the continuous observation of a trained member of staff. Monitoring may be removed once the sedating doctor is satisfied that vital signs are within normal limits for that child

14. Recovery should be complete between 60 and 120 minutes, depending on the dose used. The child can be safely discharged once they are at pre-sedation levels:
    - Conscious and responding appropriately
    - Nystagmus resolved
    - Able to walk unassisted (older children)
    - Vital signs are within normal limits
    - Respiratory status not compromised
    - Pain and discomfort addressed

15. An advice sheet (see example, appendix 3) should be given to the parent or guardian advising rest and quiet, supervised activity for the remainder of that day. The child should not eat or drink for two hours after discharge because of the risk of nausea and vomiting. The risk of ataxia may persist and lead to an increased risk of falls (in older children they should not drive for at least 24 hours).

16. The medical record and local audit documentation should be completed.

17. All adverse events should be documented and reviewed and if appropriate reported as a clinical incident.

Box 4. Ketamine doses

	CHILD
Intravenous - initial dose	1mg/kg Given over 60 seconds
Intravenous – supplemental dose if required	0.5 mg/kg Slow injection

Management of Complications and SEVERE Emergence Phenomena

These are rare

- If the patient is suffering **severe** emergency reactions and is significantly distressed then small increments of midazolam may be given in doses of 0.05-0.1mg/kg.

- If **intractable** vomiting occurs post procedure, consider use of IV ondansetron in a dose of 0.1mg/kg (maximum of 4mg) by slow intravenous injection.

- Laryngospasm
  - If the child develops stridor attempt airway repositioning, gently try suctioning and secretions and apply a high flow oxygen mask with reservoir bag.
  - If the child is saturating appropriately continue the procedure.
  - If the stridor gets worse or the child starts de-saturating let the child breathe oxygen via a bag-valve-mask. Stop the procedure. Ask for Help
  - If de-saturation reaches below 92% start gentle bag-valve-mask ventilation. Apply PEEP, if necessary. Prepare for RSI.
  - If the stridor worsens further, seek help and prepare relevant anaesthetic agent (e.g. suxamethonium) and proceed to RSI.

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Anne Frampton, Nicholas Turley, Best Practice Committee

Review

Usually within three years or sooner if important information becomes available.

Conflicts of Interest

None

Disclaimers

The College recognises that patients, their situations, Emergency Departments and staff all vary. This guideline cannot cover all possible scenarios. The ultimate responsibility for the interpretation and application of this guideline, the use of current information and a patient's overall care and wellbeing resides with the treating clinician.

Research Recommendations

None

Audit standards

None

Key words for search

Ketamine, sedation, paediatric.

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Appendix 1: Example of a Procedural Sedation and Analgesia (PSA) Checklist and Monitoring Proforma

Click here to download the checklist and proforma in excel.

Date				Patient name				
Time				Date of birth		affix label		
				Hospital number				
Planned procedure:								
Planned sedation level:		minimal						
		moderate sedation						
		deep sedation						
		dissociative sedation						
Patient factors:								
Age:			yrs		Weight		Kg	
Pregnant:	Yes		No					
Relevant co-morbidities		IHD	COPD/asthma		Obese			
		Schizophrenia	other:					
Allergies								
Normal Medications								
Acute Medications								
Recreational drugs or alcohol								
Previous anaesthetic		Yes		No				
Anaesthetic complications								
Date and time of last food								
Date and time of last oral fluid intake								
ASA grade (please circle)		**ASA I**	A normal healthy patient					
		ASA II	A patient with mild systemic disease					
		ASA III	A patient with severe systemic disease					
		ASA IV	A patient with severe systemic disease that is a constant threat to life					
		ASA V	A moribund patient who is not expected to survive without the operation					
Difficult Airway?		**no concern/ mild concern/significant concern**						
Features to consider:								
BMV ventilation:		beard, no teeth, obesity, trauma, cachexia						
LMA:		Look for characteristics of difficult intubation, Evaluate mouth opening and						
Laryngoscopy:		thyromental distance, assess Mallampati score, look for Obstruction, assess Neck						
Crithyroidotomy:		mobility. (LEMON) Check front of neck.						
Consent:	sedation		verbal		written		lacks capacity	
	procedure		verbal		written		lacks capacity	
Preprocedural ECG:			Y		N			
Pain before procedure			mild (0-3)		moderate (4-6)		severe (7-10)	
Pain post-procedure			mild (0-3)		moderate (4-6)		severe (7-10)	

	Name	Grade	Speciality	Patient Information
Sedating Practitioner				Name:
Procedural Assistant				Hosp No: Affix patient label:
Nursing staff				

Location for procedure	Resus Y ☐	N ☐	Other (details)

Date:																
Time:																
Respiratory rate (bpm)																
SpO2 %																
Oxygen delivered (l/min or %)																
Et CO2																
Blood pressure: Systolic/ Diastolic (mmHg)	240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30															
Heart Rate (bpm)																
Drugs	Units															
GCS/ Sedation level																

Level of sedation achieved:	minimal sedation	☐		
	moderate sedation	☐	dissociative sedation	☐
	deep sedation	☐	anaesthesia	☐
Interventions needed:	none	☐	ETT	☐
	hypotension rx	☐	reversal agent	☐
	BMV	☐	other	☐
	LMA	☐		☐
Adverse events:	none	☐	vomiting	☐
	hypoxia	☐	cardiac arrest	☐
	hypotension	☐	aspiration	☐
	adverse reaction	☐	death	☐

Return to baseline	yes	☐	no	☐	Eating/ drinki yes ☐	no ☐
Ambulant	yes	☐	no	☐		
Procedure Successful:	yes	☐	no	☐		
Discharge Advice given:	verbal	☐	written	☐	Sedating Practitioner signature:	
Patient satisfaction with procedure:	☐ /10					

Appendix 2: World SIVA Adverse Sedation Event-Reporting Tool [8]

World SIVA adverse sedation event reporting tool

World SIVA adverse sedation event recording tool configured for a web page or paper form. Completion of this tool requires execution of all five steps. Responses to each step will often occupy different columns.

Step 1: Was there one or more adverse events associated with this sedation encounter?

- o No, this form is now complete.
- o Yes, fill out remainder of form below.

Step 2: Please DESCRIBE the adverse events(s). Check all that apply.

Minimal risk descriptors
- o Vomiting / Retching
- o Subclinical respiratory depression[a]
- o Muscle rigidity, myoclonus
- o Hypersalivation
- o Paradoxical response[b]
- o Recovery agitation[c]
- o Prolonged recovery[d]

Minor risk descriptors
- o Oxygen desaturation (75–90%) for <60 s
- o Apnoea, not prolonged
- o Airway obstruction
- o Failed sedation[e]
- o Allergic reaction without anaphylaxis
- o Bradycardia[f]
- o Tachycardia[f]
- o Hypotension[f]
- o Hypertension[f]
- o Seizure

Sentinel risk descriptors
- o Oxygren desaturation, severe (<75% at any time) or prolonged (<90% for >60 s)
- o Apnoea, prolonged (>60 s)
- o Cardiovascular collapse/ shock[g]
- o Cardiac arrest/absent pulse

- o Other, specify below

Step 3: Please note the INTERVENTIONS performed to treat the adverse events(s). Check all that apply.

Minimal risk
- o No intervention performed

Administration of:
- o Additional sedative(s)
- o Antiemetic
- o Antihistamine

Minor risk
- o Airway repositioning
- o Tactile stimulation

or the administration of:
- o Supplemental oxygen, new or increased
- o Antisialogogue

Moderate risk
- o Bag valve mask-assisted ventilation
- o Laryngeal mask airway
- o Oral/nasal airway
- o CPAP

or the administration of:
- o Reversal agents
- o Rapid I.v. fluids
- o Anticonvulsant I.v.

Sentinel intervention
- o Chest compressions
- o Tracheal intubation

or the administration of:
- o Neuromuscular block
- o Pressor / epinephrine
- o Atropine to treat bradycardia

- o Other, specify below

Step 4: Please note the OUTCOME of the adverse events(s). Check all that apply.

Minimal risk outcome
- o No adverse outcome

Moderate risk outcome
- o Unplanned hospitalisation or escalation of care[h]

Sentinel outcome
- o Death
- o Permanent neurological deficit
- o Pulmonary aspiration syndrome[i]

- o Other, specify below

Step 5: Assign a SEVERITY rating to the adverse event(s) associated with this sedation encounter.

- o If there are any options checked in the Sentinel columns above, then this is a Sentinel[j] adverse event.
- o If the most serious option(s) checked above are Moderate risk, then this is a Moderate[k] risk adverse event.
- o If the most serious option(s) checked above are Minor risk, then this is a Minor[l] risk adverse event.
- o If the most serious option(s) checked above are Minimal risk, then this is a Minimal[m] risk adverse event.

Appendix 3: Example of Patient Information Leaflet

Ketamine Sedation: Information for Parent / Care-Giver

ABOUT KETAMINE:

Ketamine is a medication used for sedating patients who require a brief painful or unpleasant procedure. It lasts for about half an hour.

Ketamine is injected into a vein via a drip.

Under sedation, patients can appear awake but they are unaware of their surroundings. They may drool saliva, have watering of the eyes and may breathe loudly. Occasionally they can make random, purposeless movements or have twitching movements of the eyes, but they are unaware of what's going on.

SAFETY AND SIDE EFFECTS

Ketamine is very safe when used appropriately. Less than 1 in 100 children will experience a serious side-effect. Rarely, some patients will require help with their breathing while sedated. In 0.02% of cases your child may need to be given a general anaesthetic with a breathing tube placed in their windpipe to help their breathing.

Occasionally some patients will experience bad dreams either during the sedation or afterwards. This is transient and has no lasting effects on the patient. For children, it is particularly helpful to encourage them to imagine positive things before the injection. A calm manner and distraction with music, bubbles, toys etc. can also be helpful.

AFTER THE PROCEDURE

Patients can generally go home 90 minutes following the sedation. This is when they are alert, talking and walking unaided. Vomiting may occur, but again this will resolve quickly.

Patients may remain mildly sleepy or clumsy afterwards. They should be closely supervised for the first 8 hours following discharge, and (if applicable) for the next 24 hours **should not**:

- Get involved in strenuous or sporting activities.
- Use play equipment such as monkey bars, climbing frames etc.

Do let the patient sleep, and eat and drink only small amounts to minimise the risk of vomiting.

If you have any concerns that your child may be experiencing problems relating to the sedation that they have received, please contact the local Emergency Department to discuss the issues with a senior doctor or nurse.

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