

Use of ketamine sedation in the management of oral and maxillofacial paediatric trauma

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INTRODUCTION

Ketamine is a water-soluble phencyclidine derivative and has a long history as a method of relative analgesia for patients requiring treatment which is not possible without some form of pharmacological management.¹ Its mechanism of action is mainly by noncompetitive antagonism of N-methyl D-aspartic acid (NMDA) receptors resulting in sedative effects.¹ Ketamine also has mild local anesthetic effects making it an incredibly useful agent with the ability to create amnesia whilst having minimal effects on patient reflexes.¹ It has been proven particularly useful in the treatment of children in emergency departments internationally. The Royal College of Emergency Medicine's published guidance in 2009 titled 'Ketamine Sedation of Children in Emergency Departments' was developed to assist experienced emergency physicians in its use; the guidelines should be followed closely to optimize patient safety.²

This article reviews the current guidance around ketamine and its use in the management of paediatric injury; with specific discussion of its role in facilitating the treatment of oral and maxillofacial injuries.

THE ROYAL COLLEGE OF EMERGENCY MEDICINE GUIDANCE

In 2009 the Royal College of Emergency Medicine published 'Ketamine Sedation of Children in Emergency Departments.' Ketamine is described as a useful agent in providing analgesic sedation for short, painful or frightening procedures; such as suturing of lacerations under local anaesthesia, removal of foreign bodies and orthopaedic procedures including joint relocation and fracture manipulation.³

Ketamine has a wide safety margin and a study undertaken by Green and Johnson (1990) which included 11,589 cases concluded that the risk of apnoea was "exceptionally rare" and that intubation was required in only two cases (0.017%).⁴

One of the most obvious benefits of ketamine sedation is as an alternative to general anaesthesia, especially for minor and moderate procedures in combination with local anaesthetic techniques. This avoids longer recovery times, the associated risks of general anaesthesia and the significant financial cost associated with an inpatient encounter.

Although there are major benefits in using ketamine sedation, the Royal College of Emergency Medicine's published guidance discusses several contraindications which must be considered (Fig. 1).

The guidance states that children younger than 12 months old should not receive ketamine sedation and that those aged between 12 and 24 months should only receive ketamine sedation from expert staff, usually a consultant grade, due to their increased risk of airway issues.

Ketamine sedation in patients with active respiratory infection (coughs, colds) is also contraindicated as ketamine increases the production of salivary and tracheobronchial secretions, subsequently increasing the risk of laryngospasm. The adjunctive use of atropine (an antimuscarinic) or glycopyrrolate (anticholinergic) to counteract this has been a topic of contention, particularly because atropine's onset of action on salivation peaks at approximately 100 minutes post intramuscular administration, long after the issue of increased secretions.⁵ The dissociative state induced by ketamine sedation is described as "a functional and neurophysiological dissociation between the neuroocortical and limbic systems".⁶ This results in a trance-like clinical presentation whereby a patient's cardiorespiratory function is maintained but they are unresponsive to pain.⁷

The emergence phenomenon can also occur, whereby patients might experience euphoria, delirium and hallucinations during sedation.⁸ As a consequence of the above, patients with severe psychological problems, behavioral issues, previous psychotic illness and even those who experience vivid dreams should not receive ketamine sedation due to the risk of emotional distress and exacerbation of pre-existing mental health issues.

Fig. 1: Contraindications

Age less than 12 months due to an increased risk of laryngospasm and airway complications.
A high risk of laryngospasm (e.g. 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 (cognitive or motor delay, severe behavioral problems)
Significant cardiac disease (angina, heart failure, malignant hypertension)
Recent significant head injury or reduced level of consciousness
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

Although general anaesthetic is not without risk, neither is ketamine sedation. It is therefore vital that this is communicated to the patient and their legal guardians as part of the informed consent process. The Royal College of Emergency Medicine's published guidance advises obtaining written consent for both the sedation and proposed procedure. Discussion of the risks/complications should include the risk of mild agitation (20%), moderate-severe agitation (1.5%), rash (10%), vomiting (7%), transient clonic movements (5%) and airway issues (1%).¹⁴ As a consequence of the ketamine-induced dissociative state discussed above, accompanying legal guardians should be advised that the patient may keep their eyes open during the procedure and exhibit nystagmus, which may be distressing to observe.

The Royal College of Emergency Medicine's guidance discusses the administration of ketamine by intramuscular (2.5 mg/kg) and intravenous routes (slow 1 mg/kg) based on the patient's weight and not age, providing more reliable and safer sedation than benzodiazepine-opioid combinations when used responsibly.⁹ Studies suggest that there is no association between the pre-procedural fasting state and adverse events, meaning that patients may not need to fast on the day of the procedure.¹⁰ Although an un-starved patient is not a contraindication to ketamine sedation in the Royal College of Emergency Medicine's guidance, some units may still use traditional anaesthetic starving practices (6 hours without solid food, 4 hours without milk, 2 hours without clear fluids) as a precaution, depending on the urgency of the proposed procedure.

The guidance states that patients should be managed in a high dependency/resuscitation environment with immediate access to full resuscitation equipment, and should be managed by at least three members of staff (a sedationist with appropriate training in the provision of ketamine sedation and advanced airway skills, an operator and an experienced nurse). Although lack of resources is not a contraindication noted in the Royal College of Emergency Medicine's guidance, it is an important factor to consider in busy and often over-stretched Emergency Departments.

The use of ketamine in the management of oral and maxillofacial cases

Traumatic facial soft tissue injuries are the most common presentation following maxillofacial trauma.¹¹ The most common cause of soft tissue injury recorded in the literature is mechanical falls, which account for the majority of paediatric injuries. A small proportion may be the result of non-accidental injury. Although rarely life-threatening, the initial treatment of soft tissue wounds can impact significantly on aesthetics and function. This is a particularly important consideration for younger patients who are likely to become more aware of the consequences of their injuries later in life which can often impact psychologically on an individual.¹² For example, soft tissue injuries of the lips require precise approximation, especially at the vermilion border, where minimal discrepancies can later become obvious with growth.

Younger, pre-cooperative patients may not tolerate treatment under local anaesthesia without further pharmacological intervention, therefore conscious

sedation or general anaesthesia may be indicated for the management of injuries in these patients. The wide therapeutic margin of ketamine sedation makes it ideal for the management of such situations where inpatient admission and treatment under general anaesthetic can seem excessive for minor injuries.

The use of ketamine sedation in the Royal Lancaster Infirmary emergency department

The provision of ketamine sedation within the Royal Lancaster Infirmary emergency department has occurred since at least 1996.¹³ Two studies undertaken within the department included the comparison of low-dose intra-muscular ketamine sedation with midazolam (both intranasal and intra-muscular) and concluded that ketamine was the drug of choice in both studies.^{14, 15}

A subsequent study was conducted by McGlone, Howes and Joshi (2004) assessing the experience of paediatric sedation using low dose intramuscular ketamine; including discussion of adverse events. The study included 501 cases undertaken between 1996 and 2002 whereby patients received an initial dose of 2.0-2.5mg/kg intramuscular ketamine with a small number of patients requiring a second dose of 1mg/kg. Adverse events included a reduction in oxygen saturation below 93% (some below 90%), sickness in recovery or at home (one case required admission), muscle hypertonicity, disturbed sleep/nightmares and laryngospasm (one case). Eight cases required airway suctioning, of which five were being treated for mouth/lip wounds. Overall the adverse events were minimal with no children experiencing lasting complications and parent experiences were reported to be positive. It was concluded that low dose intramuscular ketamine sedation was an acceptable and safe technique when protocols were followed correctly. It was stated that low dose ketamine (2 mg/kg) warrants further study in view of potentially fewer airway complications and quicker discharge times than previously reported.¹³

Utilisation of the service by the oral and maxillofacial department

As per the Royal College of Emergency Medicine's guidance, ketamine sedation requires at least three members of staff (a sedationist with appropriate training, an operator and an experienced nurse). The repair of more complex facial soft tissue trauma, such as wounds crossing the vermilion border where accurate approximation is required, may need the attention of a specialist to ensure the best possible outcome. Therefore, the oral and maxillofacial team within the UHMB Trust occasionally undertake joint cases with the emergency department when appropriate.

Any cases involving intraoral injuries (sometimes difficult to establish with an injury to the lip) are contraindicated by the guidelines as a 'proposed procedure within the mouth or pharynx'.² These cases must be assessed as to whether a general anaesthetic is required.

A service evaluation was recently undertaken assessing the use of ketamine sedation in the emergency department to manage joint cases with the oral and maxillofacial team.

Data was collected between 01/01/19 and 31/03/19 and seven joint cases were identified with an age range of 1-6 years and a mean age 3.29 years; most of whom were patients presenting with lip lacerations.

All patients were treated within 24 hours of initial presentation to the emergency department. Three patients were successfully treated with intramuscular ketamine sedation, one patient received treatment with behavioral management alone and three patients had wounds in which the soft tissues were adequately approximated such that they did not require treatment when re-assessed.

CONCLUSION

Ketamine sedation has a long and safe history for the management of young patients attending emergency departments with injuries who would otherwise prove more challenging. However, it is vital that procedures are carried out to the highest standard in terms of safety and outcomes by following published guidance, ensuring sufficient numbers of procedures are carried out by appropriately trained clinicians and undertaking regular audit and reflection. Adopting a multi-disciplinary approach when specialist input is required ensures the best possible outcome for patients.

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