AMJ Australasian Medical Journal [AMJ 2016;9(2):25–32]

Techniques to administer oral, inhalational, and IV sedation in dentistry

Diana Krystyna Harbuz and Michael O'Halloran

School of Dentistry, University of Western Australia, Perth, WA, Australia

REVIEW

Please cite this paper as: Harbuz D, O'Halloran M. Techniques to administer oral, inhalational, and IV sedation in dentistry. AMJ 2016;9(2): 25–32. http://dx.doi.org/10.4066/AMJ.2015.2543

Corresponding Authors:
Dr Diana Krystyna Harbuz
Bachelor of Medicine and Bachelor of Surgery, MBChB
Peel Health Campus
110 Lakes Rd.
Mandurah, Perth, Western Australia, 6210
Email: diana_h35@hotmail.com

ABSTRACT

Background
Sedation in dentistry is a controversial topic given the variety of opinions regarding its safe practice.

Aims
This article evaluates the various techniques used to administer sedation in dentistry and specific methods practiced to form a recommendation for clinicians.

Methods
An extensive literature search was performed using PubMed, Medline, Google Scholar, Google, and local library resources.

Results
Most of the literature revealed a consensus that light sedation on low-risk American Society of Anesthesiologists (ASA) groups, that is ASA I, and possibly II, is the safest method for sedation in a dental outpatient setting.

Conclusion
Formal training is essential to achieve the safe practice of sedation in dentistry or medicine. The appropriate setting for sedation should be determined as there is an increased risk outside the hospital setting. Patients should be adequately assessed and medication titrated appropriately, based on individual requirements.

Key Words
Sedation, deep sedation, conscious sedation, dentistry, anaesthetic agents, pharmacology, dental phobia

What this review adds:

1. What is known about this subject?
Anxiety during dental treatment is a common issue, and without the use of sedation, dental health may be neglected.

2. What new information is offered in this review?
This review offers succinct information and recommendations for safe practice for sedation in dentistry.

3. What are the implications for research, policy, or practice?
From this review, implications for further policy include continuously updating guidelines and practice standards for sedation in all forms of health care.

Introduction

In his article, O'Halloran discusses a variety of sedation techniques, clinical indications for sedation, risks of sedation, and the importance of regulated training to ensure safe practice.[1] It is important to understand the forms of sedation that patients may require to accept dental treatment and overcome dental anxiety and phobia. Knowledge of the agents used and patient selection are essential for safe practice.[2–4]

Definitions

Sedation is a continuum from minimal, moderate, to deep as described by the American Society of Anaesthesiologists.[2,5] Anxiolysis is a decrease in anxiety

when the patient responds normally to verbal commands without resulting in conscious sedation. This is usually achieved with a single low dose or inhalational agent.[6,7]

Conscious sedation is when a medication is, or medications are, administered to result in the depression of consciousness. The patient should not require assistance maintaining their airway, cardiovascular function, or ventilation, and should respond purposefully to commands, such as verbal and light touch, for the patient's own safety and to avoid deep sedation.[7,8]

The aim is to achieve an optimum state without introducing additional risks of deep sedation or general anaesthesia. Deep sedation is not recommended for dental procedures,[9] as it is essentially not safe practice[10] due to its associated increased level of morbidity and mortality.[11]

General anaesthesia is defined as a drug-induced state in which patients do not have a purposeful response to stimulus, they lose their reflexes and their ability to protect their own airways, and there can be respiratory and cardiovascular depression.[9]

Sedation

An optimum level of sedation should be achieved with the view to avoid risks and complications.[3] If performed safely and effectively, sedation may be acceptable in both paediatric and adult populations.[12] Patient selection for the appropriateness of sedation assists with reducing risks. Tailoring requirements on an individual basis can be based on degree of fear (mild anxiety or true phobia).[3] For example, if a patient is needle phobic, premedication or topical anaesthesia prior to IV cannula insertion will be useful.[5]

A history of previous dental procedures and methods used for sedation, complete medical history, medications, and allergies are essential for planning a safe procedure as this can affect the type of sedation used. Assessment of vital signs, oral examination, and clinical examination are important to determine if they are fit for sedation in a dental practice.[3–4,13]

The choice of sedation technique and location for sedation (inpatient or outpatient) depends on many factors, including renal, hepatic, and respiratory function and relative comorbidities (see Table 1: ASA Physical Status Classification[6] with recommendations from this article).[9,14] Anxious patients have an increased risk of complications due to an increased sympathetic response. In pregnancy, the procedure should be postponed until after birth unless it is an emergency. Dental emergencies for pregnant women should be performed in hospital. Patients with intellectual or physical impairment should be assessed on a case-by-case basis.[3–4]

Appropriate discharge criteria are important to prevent complications after discharge from care. Both verbal and written pre- and postoperative instructions for fasting, transport, and postoperative supervision by a responsible adult are important for patient safety.[9]

Common techniques for sedation

Oral sedation is reasonably safe, cheap, and generally well tolerated by patients. Disadvantages include a prolonged onset and time to subside, an unreliable rate of absorption, and patient cooperation is required. There is an inability to titrate and it is usually used in a dental setting as anxiolysis.[1,3]

Intranasal agents are absorbed directly into the systemic circulation, which allows an efficient time to reach peak plasma levels.[4] An advantage is intranasal administration avoids first-pass hepatic metabolism and enteral absorption.[15]

Inhalation sedation is reasonably well tolerated, provided patients can cope with the mask, and has a good analgesic effect. This is indicated for dental anxiety, needle phobia, uncomfortable procedures, and suppression of gag reflexes. Contraindications include upper respiratory tract infections, obstructive sleep apnoea, pregnancy, and young children. Limitations include a low potency, cooperation is required, and cost. In medicine, there are multiple uses for relative analgesia/nitrous oxide sedation such as simple emergency procedures and labour.[3,4]

Intravenous administration is more commonly used for highly anxious patients, as it is the most efficient due to a rapid onset, ability to titrate the medication quickly, and the effect of a long period of amnesia. Limitations include the need for patient cooperation and adequately trained staff.[4]

Intramuscular and rectal administration are convenient, however, unsafe and not commonly used in dentistry due to variable absorption rates and an inability to titrate. Sublingual, transdermal, and subcutaneous also have limited use in dentistry.[4] Single-agent administration is safer than multi-agent as using more than one agent is unpredictable, difficult to titrate appropriately with an increased probability of adverse side effects.[6] Due to the

unpredictable concentration of sedative in the blood with a single or repeated bolus technique, it is preferable to administer intravenous sedation with incremental titration to the desired level clinical effect.[3,4]

There are two types of sedation managed by patients. Patient-controlled sedation (PCS) allows patients to self-titrate their sedation; trials have shown patient satisfaction is high and a lower requirement for a sedative with minimal cardiorespiratory complications.[16] Over sedation is rare.[2] Patient maintained-sedation (PMS) is another method in which patients can increase their own target concentration; PMS has proven effective for dental sedation.[16]

Paediatric sedation

The demand for paediatric sedation is increasing due to a growing population, and unfortunately not all specialties are strictly regulated. The American Dental Association (ADA) recommends the use of the American Academy of Pediatrics/American Academy of Pediatric Dentists Guidelines for children under 12 years old.[17]

In the paediatric population there is no level I evidence supporting sedation over general anaesthesia, however, sedation can avoid the requirement for a general anaesthetic which in itself is beneficial.[18,19] In paediatric sedation it is recommended that only ASA I patients are sedated outside a hospital environment.[13] Paediatric dentists who use sedation are required to be adequately trained.[20]

Adjuncts to sedation

Non-pharmacological options include hypnosis, acupuncture, iatrosedation, and electronic dental anaesthesia.[4,21] The efficacy of these methods are patient dependent and not as predictable as pharmacological methods.[3] Behavioural management or cognitive behavioural therapy have been shown to decrease dental anxiety.[21,22]

Local anaesthesia must be used alone or in conjunction with conscious sedation. Adequate local anaesthesia for the procedure must be provided and compensating for poor local anaesthesia by deepening levels of sedation must be avoided because of the complications associated with deep sedation in dentistry. Local anaesthesia is the loss of pain sensation to a specific area of the body by inhibiting nerve function to the area for a certain amount of time. Potential side effects include pain during infiltration, post-injection pain, nerve paralysis, visual or aural disturbances, intravascular injection, and the formation of a haematoma. Lignocaine and adrenaline can be added to prolong the effect.[4,23]

Topical anaesthesia such as gels, sprays, or ointments like topical amethocaine or EMLA cream can be used intraorally or topically to the skin for topical anaesthesia prior to cannulation.[4]

Sedation outcomes

The aim is a balance between the appropriate level of sedation and avoiding using excessive quantities of sedation. If mixed agents are used there is an increased risk of drug interactions or additive effects causing adverse outcomes.[9]

Patients with pre-existing medical conditions and the elderly are at more risk with sedation as this can change the physiology of sedation. The elderly require smaller doses of sedation and the risk of haemodynamic instability, including desaturation is far greater.[2] Sedation is not without risk, adverse events are shown to be more common with intravenous sedation in comparison to no sedation.

There is a low incidence of paediatric deaths related to sedation in a dental setting. Most deaths noted have been in a dental outpatient setting with moderate/deep sedation and usually not following the appropriate guidelines.[24]

General anaesthesia

If more sedation is required than expected, a general anaesthetic is indicated as this is safer than titrating the sedative to a point where the balance can be tipped between conscious sedation and deep sedation.[25] In very young children it may be more beneficial to elect for a general anaesthetic as opposed to sedation.[26]

Indications for general anaesthesia in dentistry include when patients are anxious, uncooperative, and needle phobic,[4,27] certain paediatric cases, and patients with intellectual or physical difficulties. These patients have an increased chance of a vasovagal response due to increased levels of autonomic activity, therefore, general anaesthesia may be more appropriate.[23] Specific paediatric cases include uncooperative or highly anxious children, significant procedures, to avoid emotional trauma, and emergency cases.[20]

Anaesthetists in dental cases should note the risk of the shared airway. Blood and debris should be removed from the oropharynx before extubation. Throat packs are useful at the onset of the procedure to prevent build-up of debris.

Stimulation of the trigeminal nerve during a dental anaesthetic can lead to an increased chance of arrhythmias.[23]

Pharmacology of important agents in dental sedation

Nitrous oxide

Nitrous oxide (N_2O) is a sweet smelling, colourless gas[2] inhaled in combination with oxygen. It is absorbed by pulmonary circulation, has a rapid uptake, and is more readily absorbed in areas with greater blood flow.[3–4] The delivery units will not allow over 70 per cent N_2O and therefore delivery of less than 30 per cent oxygen is not possible. The usual dose of N_2O for dental sedation is often between 25–45 per cent, and should be titrated to effect. A rapid onset of action and fast recovery is enabled by careful titration. It has good analgesic and anxiolytic properties and is useful for when patients have allergies to other agents.[3,4,28]

Patients usually maintain their laryngeal reflexes and haemodynamic stability.[29] High doses can lead to myocardial and respiratory depression.[3–4] Chronic exposure can lead to complications such as pernicious anaemia, which is important to consider regarding staff. The technique should be used with adequate training[3,4,29] and care needs to be taken if using other sedatives.[30] N_2O is one of the most frequently used methods of paediatric sedation.[13]

Midazolam

Midazolam is a water-soluble imadazobenzodiazepine[4] metabolised in the liver, and excreted in urine and faeces. The pharmacokinetics are not as affected by liver disease compared with other benzodiazepines.[4,] The rapid onset of action when given intravenously is beneficial and the elimination half-life is between 90–150 minutes.[4]

Intravenous dosing is 1–2.5mg for adults or 1–1.5mg in the elderly. Oral/buccal dosing is 0.5–1mg/kg with a maximum of 15mg. Intranasal dosing is 0.6mg/kg with a maximum of 10mg.[31,32] Dosing for paediatric patients is 0.02mg/kg IV and for adults 0.6–1mg titrated depending on the response.[4,18,33] Older patients and redheads usually require less sedation.[2,34] Due to the possibility of unusual responses, the antidote flumazenil should be readily accessible.[2]

Side effects include respiratory and cardiovascular depression and a paradoxical effect of excitement, confusion, and agitation occasionally in paediatric and elderly populations.[4,34]

Oral midazolam is slow onset, unreliable due to unknown individual efficacy-related hepatic first-pass metabolism,[21,34] and patients have an increased chance of postoperative nausea and vomiting. Intranasal and buccal midazolam avoid these complications.[34] The intranasal route has been suggested in paediatric populations due to more rapid onset, tolerance, and parent preference.[20] Intranasal administration can be irritating to nasal mucosa.[35]

In a dental setting, it has been shown patients prefer midazolam as a sedative to propofol when sedated with a single agent only.[35] IV midazolam is an alternative to N_2O sedation in the healthy patient.[18] In an outpatient setting, midazolam has been shown to be safe and effective when used appropriately.[35] Due to the anterograde amnesic effects of oral midazolam, patients will require a period of observation and an escort home.[3]

Adding fentanyl to midazolam has not shown to be of benefit for paediatric populations and studies have shown more adverse effects such as respiratory depression.[36]

Fentanyl

Fentanyl is a short-acting opioid, 60–80 times more potent than morphine, and with a rapid onset of analgesia and sedation. Duration of action is 30–60 minutes. Fentanyl can be titrated with doses of 25–50μg after an initial bolus of 50–100μg IV when using a single agent. If using multiple agents, a smaller bolus of 25–50μg is recommended.[31,32,37] Fentanyl is metabolised in the liver and secreted in the urine. Constipation, nausea, and vomiting are common side effects of opioid use. Serious adverse outcomes include dose-dependent respiratory depression and occasionally bradycardia.[4,32]

Propofol

Propofol is also known as 2,6 diisopropylphenol and is a synthetic sedative hypnotic agent[4] metabolised in the liver and excreted in the kidneys.[3] It is a potent hypnotic agent and is commonly used for general anaesthesia due to minimal postoperative confusion.[38] With a rapid onset of action and rapid recovery, the offset time is faster than midazolam.[2,4] Clearance is reduced in the elderly and increased in patients with a high body mass index (BMI). The average dose for sedation is 0.5mg/kg or 1.5–3mg/kg/hour maintenance. Paediatric dosing is 50–150μg/kg.[30–32]

Propofol is a central nervous system depressant, a cardiovascular depressant resulting in hypotension and a decreased heart rate and, at anaesthetic doses, respiratory

depression. Sedative doses usually have little or no effect on the respiratory system.[4]

Sedative doses are not analgesic and a large proportion of patients experience pain on injection. An antiemetic effect is described in a low number of patients.[4,] Propofol can be used in subanaesthetic doses to improve sedation if patients are resistant to midazolam or midazolam combined with fentanyl, and can be used to prevent overuse of midazolam. Propofol does have an increased risk of deep sedation with respiratory depression and should therefore be used cautiously and by experienced, trained practitioners.[9,29]

Current recommendations for sedation in dentistry in Australia

The aim of conscious sedation in dentistry is to achieve the optimum level of sedation with a wide margin of safety so that unintended loss of consciousness is unlikely.[9] In Australia, the Dental Board of Australia has a registration standard for endorsement in relation to conscious sedation. This includes a minimum of two years of general dental experience, a graduate diploma in conscious sedation (or acceptable equivalent), and only includes conscious sedation. The registered dentist is to meet all requirements approved by the Board and Australian and New Zealand College of Anaesthetists (ANZCA). The ANZCA PS09 Guidelines on sedation for dental procedures are available from the Australian and New Zealand College of Anaesthestists and Faculty of Pain.[9] N_2O alone and anxiolysis are permitted to be administered by dentists, while general anaesthesia is not. Intravenous sedation is permitted if the dentist has received appropriate training in administration and resuscitation and is assisted by a registered nurse or dentist with the appropriate level of training. General anaesthetics are to be administered by a registered medical practitioner only.[7]

Dental or medical practitioners wishing to practice sedation for dental procedures must ensure their training, equipment, monitoring, patient selection, staffing, and currency of medical emergencies preparedness comply with the requirements set out in the in ANZCA PS09 guidelines.[9]

Due to a risk of the patient losing consciousness, respiratory and cardiovascular depression, potential for medication interactions or allergies, and variations in response to medication, the practice of sedation should remain regulated. Patient factors should be taken into account and staff should be adequately trained. The facility should be appropriate and should include medications for sedation, antidotes, medical equipment and facilities, monitoring equipment and resuscitation equipment in accordance with the guidelines in ANZCA PS09.[9,34]

Conclusion

When practicing sedation in the dental setting, awareness of limitations is necessary. If the procedure is to be undertaken with adequately trained staff in an area adequately equipped, then sedation in an outpatient setting should be safe provided appropriate patient selection is performed and patients have been sufficiently pre-assessed. If this is not the case, then the possibility of adverse events and poor outcomes is increased. Single-agent administration is preferable due to the ability to titrate adequately. The route of administration and agent used should be decided on an individual patient basis.

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ACKNOWLEDGEMENTS

None

PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

FUNDING

None

ETHICS COMMITTEE APPROVAL

Not applicable

Table 1: ASA Physical Status Classification[6] with recommendations from this article[9,14*]

ASA I	ASA II	ASA III	ASA IV	ASA V	ASA VI
Healthy patients	Mild systemic disease	Chronic conditions	Severe systemic disease	Moribund patient	Brain dead patient whose organs are being removed for donor purposes[15,16]
Candidate for conscious sedation	Higher risk of complications with sedation, safe if correct precautions taken	Hospital environment only	Hospital environment only	Not appropriate for dental sedation	Not appropriate for dental sedation

*Permission to reprint ASA Physical Classification System. Approved by Dr George Kendall, June 4, 2015.