

Current status, guidelines and recommendations of sedation in Pediatric dentistry: A Literature review

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Abstract

Managing the dental needs of the pediatric population imparts a unique challenge to the dental practitioner. Pediatric sedation is a challenge which spans all continents and has grown to encompass specialties outside of anaesthesia, radiology and emergency medicine. The widespread availability of noninvasive monitoring, shortacting opioids and sedatives, and specific opioid and benzodiazepine antagonists has enabled clinicians to administer sedation safely for procedures in diverse settings. In this paper, we conducted a preliminary search to find review articles regarding sedation in pediatric dentistry and explored the current status of sedation as reflected in the published studies and reports. Evidence was collected via systematic searches through electronic databases, Google Scholar and consulted with professionals for their opinion on the subject matter. This review especially focussed on the current status, some of the relevant sedation guidelines and recommendation of sedation services in pediatric dentistry.

Key Words: Guidelines, pediatric dentistry, pediatric sedation

Introduction

The delivery of oral healthcare to anxious and uncooperative pediatric populations (<16years) poses numerous challenges¹. In order to accomplish a successful treatment care, the dentist must be able to maximize the comfort, gain the confidence and cooperation of the patient². Behavior management techniques are numerous, and may vary in terms of mode of delivery based on the individual choice of practitioners³. It includes voice control, tell show do, positive reinforcement and modeling procedure and can often be used to reduce anxiety associated with dental procedures. However, for some challenging children, these techniques alone are inadequate and pharmacological management is considered as an alternative treatment modality to facilitate provision of dental care².

If a patient is very uncooperative and the need for a dental procedure is urgent enough, the alternative treatment choice for a dentist is to use dental sedation procedures. General people immediately associate sedation with general anesthesia where the patient is put to sleep during the whole procedure and awakens afterward in a recovery room. However,

this is normally the last possible choice of treatment especially applicable for mentally challenging pediatric patients. It is very important to consider the child's age, cognitive level, coping and communication skills, physical health, attitude of parents towards anesthesia and the urgency of the procedure before proceeding for sedation procedure.

The Royal College of Dental Surgeons of Ontario (RCDSO)⁴ divided levels of sedation into three categories: (1) Conscious Sedation; (2) Deep Sedation; and (3) General Anesthesia.

The area of conscious sedation has gained more popularity than deep sedation and general anesthesia because of low risks associated and the cost. Because sedation is a continuum, it is not always possible to predict how an individual patient will respond, so the American Society of Anesthesiologists has overcome the classification of sedation with new term "Monitored Anesthesia care" which is a specific anesthesia service for a diagnostic or therapeutic procedure and include varying levels of sedation, analgesia, and anxiolysis as necessary and the potential need to convert to a general or regional anesthetic⁵. However, the main goal of

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procedural sedation is the safe and effective control of pain, anxiety, and motion so as to allow a necessary procedure to be performed⁶.

Good sedation practice requires practitioners to consider the range of non-pharmacological and pharmacological methods of anxiety management in treatment planning for individual patients. Sedative agents often include nitrous oxide, oxygen (N²O/O²), narcotics, benzodiazepines, chloral hydrate, barbiturates as well as antihistamines. The ideal pediatric dental sedative agent should possess a number of qualities including safety, early onset of drug action, adequate sedation and working time, minimal respiratory depression and patient movement⁷.

In this review, a preliminary search was conducted to find review articles regarding sedation in Pediatric Dentistry. The key words used were "Pediatric Dentistry" and "Pediatric Sedation". The searches were further limited to "English language" and "human subjects". Members of the Faculty of Dentistry and Department of Anesthesiology were also consulted regarding their professional opinions on the subject matter.

The purpose of this study is to focus on improved and safer sedation techniques which can be easily implemented for challenging children who are undergoing dental procedures.

Current Status

It is difficult to fully comprehend the current status of pediatric sedation because the reports concerning this practice are published in such a wide range of journals, and the outcome measures vary widely. Pediatric sedation practice extends over a diverse group of medical specialties including dental fraternity. Though anesthesiologists have played a critical role in establishing guidelines for safer sedation, considerable work remains in defining what represents effective and safe practice. Sedation is delivered in accordance with the American Academy of Pediatrics and American Society of Anesthesiologists guidelines and hospital policy⁸.

The American Academy of Pediatric Dentistry (AAPD) recommends conscious sedation for⁹:

- Preschool children who cannot understand or cooperate for definitive treatment.
- Patients requiring dental care who cannot cooperate due to lack of psychological or emotional maturity.

- Patients requiring dental treatment who cannot cooperate due to a cognitive, physical or medical disability.
- Patients who require dental care but are fearful and anxious and uncooperative.

The American Academy of Pediatric Dentistry (AAPD) recommends deep sedation or general anesthesia for⁹:

- Patients with certain physical, mental or medically compromising conditions.
- Patients with dental restorative or surgical needs for whom local anesthesia is ineffective.
- The extremely uncooperative, fearful, anxious or physically resistant child or adolescent with substantial dental needs and no expectation that the behavior will improve soon.
- Patients who have sustained extensive orofacial or dental trauma.
- Patients with dental needs who otherwise would not receive comprehensive dental care.

Preprocedural Analysis of the Patient's Behaviour and Medical Status

A direct history taking and physical examination should precede sedation⁶. During the initial examination, evaluation of the behavior is utmost important for a dentist so that the child's cooperative ability can be determined and this will assist the dentist in deciding whether the patient is an appropriate candidate for oral conscious sedation, IV sedation or general anesthesia. Numerous systems have been developed to accomplish this task. Two prominent classification systems have been developed by Wright and Frankl¹⁰.

Wright's behavior rating scale divides behavior into three categories

- * Cooperative
- * Lacking in cooperative ability or
- * Potentially cooperative

Frankl's behavior rating scale divides behavior into four categories:

- * Rating 1 -- definitely negative
- * Rating 2 - negative
- * Rating 3 + positive
- * Rating 4 ++ definitely positive

Some dentists develop their own scale to evaluate the behavior of young children in the dental setting. No matter what system a practitioner uses, the essential issue is that preoperative behavior should be documented and considered when formulating a treatment plan.

Underlying medical problems should be assessed (Table 1), and information about medication use, allergies, previous adverse experiences with sedation or general anesthesia, and the time and nature of the last oral intake should be recorded. Ideally the diagnosis and treatment planning should be carried out on a separate day from that of the sedation^{11,21,13}. This has several advantages, including:

- Allowing the dentist sufficient time to fully explain the treatment required and assess the parent's understanding.
- Allowing the parent and child time to consider the proposed treatment, and ask further questions if necessary.
- The pre-operative anaesthetic assessment may be carried out immediately prior to the surgery by anesthesiologist.

Explanation of Risk

- Once a decision has been made to use sedation, it should be explained to the parents that the drug is not administered by a dentist, but by an anaesthetic consultant who has undergone specialist training in paediatric anaesthesia. It should also be explained that the procedure will take place in an operating theatre, with a team of trained professionals. The potentially expected drug side effects should be clearly explained to the parent(s) and, where appropriate, the patient¹⁴.

Sedation Guidelines and Recommendations

Most of the guidelines are based on the degree/ level of sedation induced/achieved rather than the specific pharmacologic agent administered⁶. These guidelines differs based on mode of action of medications, routes of delivery, Nil Per Oral (NPO) status, and physiological monitoring status.

Table 1. Physical-Status Classification of the American Society of Anesthesiologists⁷

CLASS	DESCRIPTION	EXAMPLES	SUITABILITY FOR SEDATION
1	A normally healthy patient	Unremarkable medical history	Excellent
2	A patient with mild systemic disease (no functional limitation)	Mild asthma, controlled seizure disorder, anemia, controlled diabetes mellitus	Generally good
3	A patient with severe systemic disease (definite functional limitation)	Moderate-to-severe asthma, poorly controlled seizure disorder, pneumonia, poorly controlled diabetes mellitus, moderate obesity	Intermediate to poor; consider benefits relative to risks
4	A patient with severe systemic disease that is a constant threat to life	Severe bronchopulmonary dysplasia, sepsis, advanced degrees of pulmonary, cardiac, hepatic, renal, or endocrine insufficiency	Poor, benefits rarely outweigh risks
5	A moribund patient who is not expected to survive without the operation	Septic shock, severe trauma	Extremely poor
6	A declared brain-dead patient whose organs are being removed for donor purposes	-----	-----
E	Emergency operation of any variety (used to modify one of the above classifications, i.e., ASA III-E).		

The sedation area must include all necessary age appropriate equipments for airway management and resuscitation, an appropriately sized bag-valve mask, oxygen, suction and endotracheal tubes.

Patient monitoring

The most important element of monitoring during sedation is close, continuous observation of the patient. Monitoring devices should include electrocardiography (ECG) machines, pulse oximeters, and defibrillators¹⁵.

Continuous clinical observation

Complete, continuous and careful monitoring is required after the administration of the drug, on completion of the procedure, during early recovery, and at the completion of recovery, as this is the most important element in patient monitoring. Clinical monitoring include Response by the patient to

- Physical stimulation
- Verbal command -
- Observing breathing
- Movements of the thorax
- Passage of the air stream
- Respiratory frequency
- Observing skin colour

Table 2 is a sedation scale, that can be used to monitor the effect of the sedation¹⁶.

Pulsoximetry

The use of pulse oximetry has been widely discussed. In the case of conscious sedation, oxygen desaturation (i.e. below 95%) is probably rare. It is vital that the staffs are adequately trained in the use of clinical monitoring, and if used the management of electronic monitoring. When pulse oximetry is used, more that 3 out of four of the alarms may be false positives due

Table2: Sedation scale according to Wilton¹⁵

Agitated	Clinging to parent and/or crying
Alert	Awake but not clinging to parent, may whimper but not cry
Calm	Sitting or lying comfortable with eyes spontaneous open
Drowsy	Sitting or lying comfortable with eyes spontaneous closing but responds to minor stimulation
Asleep	Eyes closed, rousable but does not respond to minor stimulation

to movement artefacts, sensor displacement or other reasons. Young children especially may react with increased anxiety to the placement of the pulseoximeter. Recommendations for dosages in pediatric procedural sedation and analgesia are described in Table 3.

Nil Per Oral (NPO) Guidelines

According to the guidelines of the American Society of Anesthesiologists, children should not consume clear liquids for two to three hours or solids and nonclear liquids for four to eight hours before undergoing sedation for an elective procedure; the recommended duration of fasting varies with age. However, the guidelines acknowledge that “the literature provides insufficient data to test the hypothesis that preprocedural fasting results in a decreased incidence of adverse outcomes of procedural sedation”⁶.

- Clear liquids: 2 hours
- Breast milk: 4 hours
- Infant formula: 6 hours
- Nonhuman milk: 6 hours
- Light or solid meal: 6 hours

Clear liquids are non-fruity juice, water, tea, and coffee. All milk products (non-clear liquids) are considered as solid foods. Children under school age shall drink sugar containing clear liquid up to 2 hours before treatment in order to avoid low blood sugar.

For the emergency patient, where proper fasting has not been assured, the increased risk of sedation must be weighted against the benefits of the treatment, and the lightest effective sedation should be used. If possible, such patients may benefit from delaying the procedure. Nitrous oxide if used alone does not require any NPO status.

The NPO recommendations are based upon preliminary, inconclusive or conflicting evidence and state that “recent food intake is not a contraindication for administering procedural sedation and analgesia but should be considered in choosing the timing and target level of sedation”¹⁷.

Discussion

The need for sedation in uncooperative and challenging children has increased over the past decade, paralleling the increasing volume of procedures which are being performed by different specialists in areas outside of the operating room. Thousands of children are

Table3: Recommendations for Dosages in Pediatric Procedural Sedation and Analgesia

Drug	Clinical effects	Dose	Time of onset	Duration of action (minutes)	Adverse effects
Sedative-hypnotic agents Chloral hydrate	Sedation, motion control, anxiolysis. No analgesia. Not reversible.	PO: 25–100 mg/kg of body weight; after 30 min may repeat 25–50 mg/kg. Maximal total dose: 2 g or 100 mg/kg (whichever is less). Only single use in neonates.	15-30	60-120	paradoxical excitement, vomiting, dizziness, diarrhoea, headache
Midazolam	Sedation, motion control, anxiolysis. No analgesia. Reversible with flumazenil	IV (age of child, 0.5–5 yr): initially 0.05–0.1 mg/kg, then adjusted to a maximum of 0.6 mg/kg IV (6–12 yr): initially 0.025–0.05 mg/kg, then adjusted to a maximum of 0.4 mg/kg IM: 0.1–0.15 mg/kg PO: 0.5–0.75 mg/kg IN: 0.2–0.5 mg/kg PR: 0.25–0.5 mg/kg	2–3 10–20 15–30 10–15 10–30	45–60 60–120 60–90 60 60–90	Hypotension, respiratory depression, Paradoxical reaction, Hallucinations
Pentobarbital	Sedation, motion control, anxiolysis. No analgesia. Not reversible.	IV: 1–6 mg/kg, adjusted in increments of 1–2 mg/kg to desired effect IM: 2–6 mg/kg, to a maximum of 100 mg PO or PR (<4 yr): 3–6 mg/kg, to a maximum of 100 mg PO or PR (>4 yr): 1.5–3 mg/kg, to a maximum of 100 mg	3–5 10–15 15–60	15–45 60–120 60–240	paradoxical excitement. Avoid in patients with porphyria.
Analgesic agents Fentanyl	Analgesia. Reversible with naloxone.	IV: 1.0 µg/kg/dose, may repeat every 3 min, adjust to desired effect	2-3	30-60	dry mouth, nausea, vomiting, constipation; headache, drowsiness
Ketamine	Analgesia, dissociation, amnesia, motion control. Not reversible	IV: 1–1.5 mg/kg slowly over period of 1–2 min, may repeat 1/2 dose every 10 min as required IM: 4–5 mg/kg, may repeat after 10 min	1 3–5	Dissociation: 15; recovery: 60 Dissociation: 15–30; recovery: 90–150	unpleasant hallucinations and dreams during the recovery period, dysphoric emergence reactions
Nitrous oxide	Anxiolysis, analgesia, sedation, amnesia (all mild)	Preset mixture with minimum of 40% oxygen self-administered by demand-valve mask (requires cooperative child)	<5	<5 after discontinuation	over sedation, nausea, vomiting, dysphoria, sweating, restlessness, headache, tinnitus and urinary incontinence
Reversal agents (antagonists) Naloxone	Opioid reversal	Overdose of opioids IV or IM: 0.1 mg/kg/dose, to a maximum of 2 mg/dose; may be repeated every 2 min as required	IV: 2 IM: 10–15	IV: 20–40 IM: 60–90	sweating, severe nausea or vomiting; severe headache, anxiety, confusion
Flumazenil	Benzodiazepine reversal	IV: 0.02 mg/kg/dose, may be repeated every 1 min to a maximum of 1 mg	1–2	30-60	weak or shallow breathing, continued drowsiness, confusion, fear, panic attack

sedated safely by dentists daily in the United States. Although the incidence of mortality and morbidity associated with sedation are rare, the focus on safety of sedation must remain a top priority. Retrospective analysis have reported most mishaps to be generally attributed to the following four things:^{18,19}

- * Inadequate preoperative evaluation
- * Lack of knowledge concerning the pharmacology of drugs employed

- * Inadequate monitoring during the procedure
- * Lack of training in the management of emergencies

American Dental Association and American Academy of Pediatric Dentistry have listed guidelines for different levels of sedation for monitoring and management of paediatric patients during and after sedation for diagnostic and therapeutic procedures.^{20,21} For clinicians using sedation to deliver treatment to their patients, it

is strongly recommended that one should comply with the guidelines so that the treatment procedures are carried out under the optimal conditions. According to Shapira et al.²² the ideal dental sedative should possess a number of qualities, including safety, minimum respiratory depression, adequate sedation, minimal patient movement, early onset of drug action, adequate working time and early recovery. It remains unclear as to which sedative agents have best outcomes as many sedation regimens fail to possess all of the qualities.

A review study done by McComb et al.²³, has shown that young children who experienced sedation for their dental treatment exhibited good behavior when subsequent dental treatment was provided.

We found that the vast majority of publications concerned with sedation in dentistry were not reported well enough to enable a reliable judgement to be made about how the trials had been conducted including the validity of the results. With well-trained

clinicians and anaesthetic staff, full equipment set-up and following standardized protocol, sedation offers a viable option for such patients whose dental treatment may otherwise be impossible to render.

Future Direction for Pediatric Sedation Research:

In considering the current status of pediatric sedation and the safety issues involved, the future can be viewed as an opportunity to provide clarity through collaborative research and clinical program development. There is a need to better define the effectiveness and risks associated with the various sedation protocols. As is the case with anesthesia, large clinical trials or databases are required to sort out the frequency of critical events. Information collected from the various institutions and including providers from a multitude of pediatric specialties and practice settings would allow meaningful data analysis on: which drugs are being used, how they are delivered, by whom, and with what kinds of outcomes.

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