

# Intravenous Procedural Sedation: An Alternative to General Anesthesia in the Treatment of Early Childhood Caries

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## A b s t r a c t

*Providing comprehensive dental treatment for preschool children with early childhood caries (ECC) is probably the greatest challenge facing most dentists; many elect to hospitalize a child with ECC and provide treatment under general anesthesia. However, as waiting lists for hospital admission are long, ECC continues to progress and can cause pain or acute infection. Hospital treatment also results in substantial costs beyond those for dental treatment. This paper describes a cost-effective intravenous sedation program being used in a pediatric dental practice in Kelowna, British Columbia. The program offers an alternative to general anesthesia that allows qualified dentists to provide comprehensive dental treatment to children with ECC safely and efficiently in the private practice setting.*

**MeSH Key Words:** anesthesia, dental/methods; anesthetics, intravenous; dental care for children/methods

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Although the prevalence of dental caries has declined among the population as a whole, early childhood caries (ECC) is recognized as a significant public health problem among preschool children,<sup>1,2</sup> especially children from certain ethnic groups<sup>3</sup> and those living in poverty.<sup>4</sup> While various preventive strategies have been developed and tested in selected populations with varying degrees of success,<sup>5</sup> comprehensive treatment is still required for a large number of children with ECC. Arguably, a child with ECC presents the greatest challenge most dentists will face.

Historically, dentists treating uncooperative children with extensive dental disease, including ECC, have relied on a variety of patient management strategies, including behavioural, nonpharmacologic techniques,<sup>6,7</sup> different combinations of oral sedatives, nitrous oxide–oxygen sedation, and general anesthesia (GA),<sup>8</sup> to deliver quality treatment safely and compassionately. These procedures have enjoyed varying degrees of success in eliminating uncooperative behaviours, with oral sedation (OS) and nitrous oxide–oxygen being the least successful and most unpredictable,<sup>8</sup> especially in young children, and GA being the most successful. Many young children lack the emotional and social maturity to allow treatment to

proceed when behavioural, nonpharmacologic management techniques alone are used.

GA is the most common modality for managing uncooperative children with ECC. However, as waiting lists at Canadian hospitals continue to increase, in the opinion of many, to unworkable lengths, children with ECC experience a progression of their condition to the point where many develop pain and acute infection before the scheduled treatment date. Studies have shown<sup>9,10</sup> that ECC can have a profoundly negative impact on the quality of life and general growth and development of affected children. Increasing waiting times for dental surgery will only exacerbate these problems. Although private surgical facilities offer a partial solution, many families do not have the financial resources to choose this option and many communities cannot support these facilities. The costs of providing GA in a hospital or private facility range between \$600 and \$1,500 for anesthesia and facility services alone.<sup>11</sup>

Pediatric dentistry has been slow to embrace patient management strategies employed in pediatric medicine, such as intravenous procedural sedation (IVPS), when invasive and potentially painful dental procedures must be performed on uncooperative children. The costs of providing IVPS are substantially less than those associated



**Figure 1:** Sedated child with an intravenous line placed in the dorsum of the right hand. The child has been placed into a protective stabilization device. Note that his head has not yet been properly positioned. Monitoring equipment in the background consists of a pulse oximeter/NIBP/EKG monitor, capnograph and defibrillator. These monitors are placed on a crash cart that contains essential emergency drugs and supplies.



**Figure 2:** The child's head is now properly positioned. A Vac Pac (Olympic Medical, Port Angeles, Wash.) is used to stabilize the head in a sniffing position during sedation. The pretracheal stethoscope monitors respirations intraoperatively.

with GA. Moreover, since the practitioner controls patient scheduling for in-office IVPS, children usually receive treatment faster and at greater convenience to parents. IVPS is a powerful and predictable method for sedating children,<sup>12</sup> and because the agents used in IVPS are titratable (unlike those used for OS), the procedure has a wider margin of safety. Furthermore, unlike some of the popular agents used in OS (e.g., chloral hydrate and antihistamines), the primary agents used in IVPS regimens — benzodiazepines and opioids — are readily reversible should a complication arise or if an undesirable depth of sedation is reached. It is important to recognize, however, that practitioners who wish to use IVPS must obtain advanced training.

This paper compares the use of IVPS and GA to treat uncooperative children with ECC in a private practice setting in Kelowna, British Columbia.

### The Kelowna Experience

Kelowna is located in the Okanagan Valley and has a population of 95,000. As the largest city outside of the Lower Mainland, it has become a tertiary medical centre for the Southern Interior of British Columbia. Because the author's practice is the only pediatric dental practice between Calgary and the Lower Mainland of British Columbia, Kelowna has become a tertiary care centre for children requiring specialist pediatric dental services. Children are referred from a large geographic area encompassing both the Interior and Northern Health Authorities, 2 of the 6 administrative units that administer health care in British Columbia. Many families must travel long distances to access care in Kelowna. Hence, an important goal is to complete all necessary treatment in one appointment.

Children must be seen initially for a consultation, at which time a diagnosis is made, a treatment plan developed

and various treatment options presented to the parents. A decision is also made, on the basis of the child's medical history, present state of health and treatment requirements, whether treatment can proceed with local anesthesia and nonpharmacologic techniques, IVPS or GA. Only children who are healthy (ASA 1) or have a well-controlled and minor medical condition (ASA 2) are eligible for treatment in the office under IVPS. The sedation protocol, including drugs and dosages, has been previously described (Figs. 1 and 2).<sup>12</sup> Children with more severe medical conditions who require extensive dental treatment and exhibit high anxiety or uncooperative behaviour are treated under GA after an anesthesia consult.

IVPS is generally restricted to children 30 months of age and older. For procedures such as extracting several painful teeth, IVPS can be safely administered to children under 30 months of age because the appointment length is very short and drug dosages needed to induce cooperation under sedation are small. The decision to limit IVPS to children 30 months of age or older in this author's practice is arbitrary and largely based on our training and experience in providing comprehensive restorative treatment to children with ECC. The treatment required, its urgency, the speed with which the treatment can be accomplished, airway evaluation, and a child's behaviour and social competence as determined during the consultation appointment are several important factors that need to be considered when deciding whether to offer treatment under IVPS or GA. The author's experience in using IVPS to provide comprehensive restorative care to children under 30 months of age is limited. However, in the few cases completed to date, drug dosages required to secure cooperation in this age group were often higher than those needed for older children. Increasing drug



**Figure 3:** The author and a certified dental assistant treat a 5-year-old boy under IV sedation. Note the patient's head position and protective stabilization to prevent random movement.



**Figure 5:** Appropriate staffing is essential when moderate levels of sedation are used. One registered nurse draws midazolam from a multidose vial for administration as a preoperative oral sedative, while the other registered nurse monitors the patient and administers medication at the author's direction.

dosages may lead to deep sedation. This is a scenario practitioners must try to avoid when sedating a child in this age group, as the risk of respiratory complications increases significantly when sedation deepens.

In the last five years, 1,832 children with ECC have received treatment under IVPS in the author's private practice (Figs. 3 to 5). The mean age of the children was 35 months. The mean treatment time was 65 minutes, with a range of 30 to 115 minutes. Comprehensive dental treatment, including extracoronal and intracoronal restorations, pulp therapy and removal of unrestorable or



**Figure 4:** Appropriate monitoring is essential when sedating a child. This monitor measures heart rate, SpO<sub>2</sub>, diastolic and systolic blood pressure, respiratory rate and temperature, and provides a lead II electrocardiogram tracing.

abscessed teeth, was accomplished in one appointment. The mean IVPS fee was \$140, with a range of \$80 to \$236. The mean cost to the author for providing IVPS was \$62, with a range of \$32 to \$104. This amount included the wages for one registered nurse who was responsible for assessing the patient before treatment, administering a preoperative sedative, monitoring the patient during and after treatment and recording vital signs, discharging the patient to a responsible parent and reviewing discharge instructions with the parent.

During the same time period, 432 children with ECC were treated in hospital under GA. The mean age of the subjects was 32 months, with most children between the ages of 19 and 28 months. Several parents of older children requested treatment under GA, which increased the mean age of the children treated. The mean treatment time was 60 minutes, with a range of 30 to 110 minutes. The mean total cost for treatment under GA was \$1,105. The mean cost per patient for hospital-related services was \$775. The mean anesthetist's fee was \$360, which in some cases included the cost of a preoperative history and physical by the anesthetist. Hospital-related costs included the salaries of registered nurses working in the day surgery unit, the operating room, post-anesthesia recovery area and the pediatric ward, the salaries of clerical staff responsible for booking and admitting patients, and costs for OR and anesthesia supplies and equipment, as well as OR maintenance after each case.

None of the children suffered adverse events intraoperatively with either IVPS or GA. During IVPS, a significant proportion of the children cried at some juncture in the treatment, in particular when a rubber dam was placed, local anesthesia was administered and, oddly, when teeth with newly placed proximal restorations were flossed. Parents should be warned beforehand that the child may cry during treatment when IVPS is used. These disruptions had

no effect on treatment but served as important indicators of child comfort and depth of sedation. Both groups of children cried or struggled at the conclusion of treatment when monitors were removed and they were being transported to the recovery area. Eight per cent of children treated with IVPS experienced postoperative nausea or vomiting, compared to 7% of children treated under GA. None of the children treated with GA or IVPS required hospital visits after discharge since there were no postoperative complications.

## **Discussion**

This article has shown that IVPS can be a suitable alternative to GA for some children with ECC. Not all children with advanced dental disease, however, are suitable for IVPS. The very young (less than 30 months of age), children with respiratory, cardiac or metabolic conditions for which IVPS may increase the risk of complications, or children with extensive treatment requirements that may result in a lengthy sedation appointment are better managed under GA. Practitioners must be adequately trained and educated to use IVPS and must follow provincial sedation guidelines. For these reasons, the author does not recommend the use of IVPS by family dentists to treat children with ECC. This technique should be restricted to specialists with advanced training in pediatric anesthesia and sedation.

Incorporating IVPS into pediatric dental treatment has many advantages. Because treatment under IV sedation does not require a hospital visit, it may be less traumatic for both the child and the parents. Costs to provide treatment under GA, although not borne directly by the parents, are much higher than the costs of providing the same treatment under IVPS. With IVPS it is possible to reverse sedation rapidly if complications ensue during treatment. There is low morbidity and mortality associated with IVPS<sup>13</sup> when it is administered by qualified personnel who adhere to recognized sedation standards.

OS is widely used in pediatric dental practices to manage uncooperative children. However, the failure rate of OS is approximately 40%, primarily because the absorption of sedative agents is unpredictable.<sup>8</sup> Most OS regimens do not have sufficiently long durations of action to allow completion of treatment in one appointment. Sometimes 2 or 3 appointments are necessary to complete treatment for ECC under OS. This increases the costs to parents and causes greater inconvenience to the family, especially if travel and time away from work are considered. Nonetheless, it is likely that OS will continue to occupy an important place in the behaviour management armamentarium of pediatric dentists. This paper argues that, given the high failure rates and the need for multiple appointments with OS, IVPS should assume a larger place in managing the behaviour of uncooperative children in pediatric dental offices. IVPS is more predictable than OS

and has a higher success rate because medications can be titrated as needed during treatment. It can also be argued that IVPS is safer than OS if benzodiazepines and opioids are used, as there are reversal agents for each of these drug classes. The effects of some commonly used medications for OS (e.g., chloral hydrate, antihistamines and hydroxyzine) cannot be reversed, which is a significant disadvantage over IVPS.

Continuing education on IVPS is available in the United States under the auspices of the American Dental Society of Anesthesia. The curriculum is standardized, modular in design and competency-based. Successful candidates must be licensed and certified in advanced life support, must complete each module and demonstrate competency in a defined number of IVPS cases, which they administer under instructor supervision.

As with any treatment procedure, there are disadvantages associated with IVPS. Significant training is required before a practitioner can master the technique; currently no undergraduate program or graduate program in pediatric dentistry in North America offers this training. Appropriate patient selection and preoperative patient assessment is critical. Providing this treatment in the practice requires that the dentist purchase essential monitoring and emergency equipment. Staff with appropriate training must be employed when IVPS is used. Most provinces require that a qualified person, such as a registered nurse, be present in the treatment room whose sole purpose is to monitor the patient during and after treatment and to record vital signs at specific intervals. The operator must not also act as the sedationist during IVPS. Office design should take into account an IVPS program. A dedicated recovery room may be required, although a vacant dental operatory has all the attributes necessary. Hallways and doorways may need to be slightly wider than usual to accommodate wheelchairs or, in rare circumstances, stretcher beds. As most provincial building codes require that dental offices be fully accessible to those with disabilities who may use assistive devices, this latter issue is less of a consideration.

## **Conclusions**

Equipment and training to provide GA is far more expensive than what is required for IVPS. The costs of providing GA in Canada are covered by the public health care system if the procedure is undertaken in a hospital or an accredited private facility; ultimately, the taxpayers are the ones who must bear those costs. The costs for IVPS are usually paid either by a private dental insurance plan or by the parents. The dental condition of a child who must wait many months for treatment under GA will likely deteriorate, and the progression of decay may also result in higher treatment costs. What cannot be quantified so easily is the pain and suffering a child may endure while waiting many months for admission to a facility that provides GA.

In comparison, pain and suffering can be eliminated much more quickly in a private practice setting, where a pediatric dental team qualified to perform IVPS can more easily schedule necessary treatment.

This article has described the use of IVPS to manage young children who required dental treatment for ECC. The experience in Kelowna has shown that IVPS can be both a successful and a cheaper alternative to GA for the treatment of children with ECC. The article has also discussed important limitations and considerations in the use of IVPS for the treatment of children with ECC. ♦

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