

Different Aspects of General Anesthesia in Pediatric Dentistry: A Review

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Abstract

Context: Most child population is able to undergo dental treatment in the conventional setting. However, some children fail to cope with in-office conscious state and cannot respond to usual management modalities. This review aims to discuss the topic further.

Evidence Acquisition: A computerized search in databases PubMed, MEDLINE, EMBASE, Google Scholar and Google were performed using dental general anesthesia related keywords. Original and review English-written articles that were limited to child population were retrieved without any limitation of publication date. The suitable papers were selected and carefully studied. A data form designed by author was used to write relevant findings.

Results: Preoperative oral examination and comprehensive evaluation of treatment needs is only possible after clinical and radiographic oral examination. Effective collaboration in dental GA team should be made to minimize psychological trauma of children who undergo dental GA. Before conducting comprehensive dental treatment under GA, the general health of the child and the success rate of procedures provided needs to be accurately evaluated. It is noteworthy that determination of the optimal timing for GA dental operation is of great importance. Providing safety with pediatric dental rehabilitation under GA is critical.

Conclusions: Besides criteria for case selection of dental GA, some degree of dental practitioner's judgment is required to make decision. Pre- and post-operative instructions to parents or caregiver decrease the risk of complications. However, trained resuscitation providers, careful monitoring and advanced equipment minimize adverse outcomes.

Keywords: Children, Dental Care, General Anesthesia

1. Context

Pedodontists treat most children adequately using behavioral techniques. However, certain children cannot receive treatment via these methods (1). Dental treatment using general anesthesia (GA) is a rehabilitation treatment for pediatric patients (2). GA is a controlled state of unconsciousness in which protective reflexes is lost (3). It is nearly three decades that comprehensive dental rehabilitation under GA has been offered to pediatric population (4).

In some cases, dental GA is the most practical and cost-effective mode of treatment (5). According to the American Academy of Pediatric Dentistry (AAPD), a certain patient population who may not tolerate routine dental treatment can only be treated under GA (6, 7). Pediatric patients with a very young age, or those suffering physical, mental, cognitive or emotional immaturity or disability or those with extreme anxiety who need extensive rehabilitation are treated using GA (1, 7-10). These children are not suitable candidates for conventional in-office treatments and are more safely and effectively treated under GA (9). The majority of dental GA candidates are children who suffer from one prevalent health

problem, early childhood caries (ECC), and are otherwise healthy (2, 8, 11-16).

2. Evidence Acquisition

This paper was designed as a review on the different aspects of dental GA in child population. The review included an electronic search in PubMed, MEDLINE, EMBASE, Google Scholar and Google, databases using "dental general anesthesia", "comprehensive dental rehabilitation", "full mouth rehabilitation" terms. In this review, only English written articles, both in original or review type, restricted to child population, without any restriction of publication date was included.

For gathering more relevant articles, the references of different articles were again searched. Subsequently, the content of papers that were reasonable at the first glance, were studied. Then, the author reviewed the full text of papers carefully and excluded the misleading ones. After choosing the most relevant articles, the author-designated special form was used to record suitable finding.

3. Results

In the present review, the final number of articles determined as suitable for discussing the topic was 22 papers. The main findings of electronic search are addressed below.

3.1. Preoperative General and Oral Evaluation

For each GA-candidate patient, initial screening should be performed (17). Children who represent indication of treatment under GA should be evaluated carefully by taking history and thorough physical examination (5, 18). Physical examination reveals whether it is possible to offer dental treatment using GA.

3.2. Preoperative Instructions

Parental compliance with pre-operative instructions is one critical factor to keep the child safe during GA and recovery and minimize the risk of intra-operative and post-operative complications (6). The printed guidance regarding eating and drinking is given to the parent or caregiver on the day of consultation. Providing parents with this information gives them more preparation about the day of operation (19). Moreover, a short explanation about the type of required dental treatments and estimated operation time needed may be helpful to assure the parents and reduce their concerns.

3.3. Consent

A written and informed consent form should be carefully completed by parents or caregivers. In the form as well as verbally, the dental practitioner explains the use of GA and dental procedures. The entity, risk, and benefits of GA procedure is clearly explained to the parents. Furthermore parents should be informed about the likelihood of performing additional or alternative treatments found necessary during the course of operation on the basis of operator's decision.

3.4. Psychological Preparation

Psychological management is highly helpful to permit patients to allay their distress and for building a constructive interaction (15). Simple explanation, game playing and distraction are some methods to reduce patient fear. Another possible way to help the children to cope with their emotional trauma is the parental presence. It has been well documented that personality changes are highly age-related. This sequence is more prevalent in patients aged 1-5 years who represent the greater candidates for dental GA (15, 17).

3.5. The Various Techniques and Agents for Induction of Dental GA

Mask induction, rectal induction, oral route or nasal transmucosal agents, IM or IV injections are various techniques for induction of anesthesia. Due to fear of injec-

tions, inhalation anesthesia induced by halogenated volatile anesthetics is routinely used in child patients. Nitrous oxide, isoflurane, desflurane and sevoflurane are inhalation agents. Due to pleasant odor, low blood/gas partition coefficient and less respiratory problems, sevoflurane is the choice induction agent (20). Sevoflurane causes less episodes of hypotension than halothane (21). For anesthesia maintenance isoflurane, desflurane and sevoflurane are suitable (20).

3.6. Procedures and Their Quality

In a single session under GA, different procedures including amalgam or composite restorations, pulp treatments, stainless steel crowns (SSCs) and extractions are offered. The strategy is to perform more extraction and SSCs and fewer pulp treatment and amalgam or composite restorations (6).

In the phase of treatment planning, more radical treatments should be selected (15, 22). Teeth with doubtful prognosis need to be removed (23). Using this planning reduces the likelihood of complications and another dental GA [15]. Without these precautions, most of cases required dental GA retreatment after first full mouth rehabilitation. Providing another GA, in turn, makes further risks including morbidity and mortality and behavioral consequences are increased.

Among restorative procedures, SSCs have higher success rate than multi-surface complex amalgam. SSCs are the most durable and functional restorations which can decrease the need of retreatment in teeth with interproximal caries (22). This is particularly true in very young children.

Grossly unrestorable or questionable teeth should be extracted. Tooth extraction is preferred when there is doubt about the success rate of procedure (6). The current concept is to encourage extraction of teeth with necrotic pulp rather than preserve them by pulp treatment (22). Complex treatments such as pulp therapy for teeth with pre-apical lesion or necrotic pulp should be avoided (1). When pulp treatment option is considered, vital pulpotomy is more frequently adopted (22).

Another factor which may affect treatment planning is underlying medical conditions (4). In medically or mentally complicated patients, treatment modality such as tooth extraction is preferred (4, 6). Dentist plans less preventive measures in dental GA modality (1, 4).

3.7. The Use of Supplemental Local Anesthesia in Conjunction with GA

Addition of local anesthesia during GA is an area with a spectrum of practices (18, 24). It has been documented that the utilization of local anesthesia improves hemorrhage control and physiologic parameters. In addition, it reduces post-operative pain at the operation site (25-27), need for anesthesiologist intervention, and complication upon recovery (24).

Extent of treatment is among the main factors leading dental practitioner to prefer intraoperative local anesthetic (28). On the other hand, some dental practitioners do not administer local anesthesia due to concerns regarding lip and cheek biting (24, 28). In respect of dental procedure, extraction of teeth is the most common reported dental procedure for which local anesthesia is delivered (24).

3.8. The Optimal Timing of Dental Rehabilitation for Children Undergoing GA

To avoid a second GA, it is proposed that the procedure be delayed until the primary dentition is fully completed (6).

3.9. Duration of Operation

The time required for completion of dental rehabilitation is considerably fluctuating [5]. Because of operation complexity, estimating operation time is not exact. Most of operations may take longer or shorter duration than estimated preoperatively (9).

In average, 1-4 hours is the routine treatment time elapsed (6, 29). The time required for operation is influenced by some parameters such as age and American Society of Anesthesiology (ASA) classification of patient; number of teeth restored and type of dental procedure. Generally extractions require less time than restorations (9).

3.10. Advantages of Comprehensive Dental Rehabilitation Using GA

Under GA all required treatments are performed in a single session in a hospital environment providing efficient services in a safe mode (4, 8, 15). Moreover, GA is one modality to ensure that the child received effective pain control (9).

The other benefit of GA does not need child cooperation as one requirement of treatment (14). Dental GA is more convenient and cost saving than treatment in office setting (3, 5). It has been reported that dental treatments under GA have greater quality and durability than conventional treatments (9, 15).

Since general well-being and quality of life is greatly influenced by oral health (30), oral health-related quality of life can be used as one method to measure the outcome of dental rehabilitation under GA (15). Recent studies evaluated the impact of dental treatment using GA on children's quality of life. It is well documented that children who underwent this treatment show significant improvement in their quality of life (4, 9, 13, 15).

3.11. Disadvantages

All anesthetic agents are associated with some hazard and risk to patient's overall health with some reports of morbidity and mortality (5, 17). Pediatric dentists must limit dental treatment using GA in cases which routine office practice is not applicable for them (17).

Injuries to tooth, lip and other soft tissues are also reported (31). Dental trauma occurs during laryngoscopy and endotracheal intubation. The other reason is the incorrect or forceful use of mouth openers. Dental trauma differs from enamel crack to avulsion, hypoplasia, and crown dilacerations (31).

3.12. Documentation

Clinical records documenting any treatment procedure performed (restorations, pulp treatments and extractions) should be available. Moreover, it is the duty of anesthesiologist to record the details of anesthetic procedure and any complications (9).

3.13. Patient Safety

In fact, GA is a modality with its inherent risks and has also unique benefits (23). With regard to the increased percentage of children who had received GA for dental procedures over the past two decades (32), it is needed to focus more on safety aspects of dental GA. A range of negligible to 90% of post-operative morbidities have been reported (23). Arrhythmias, dislodged or obstructed endotracheal tube, IV infiltrates or disconnects, edema of the tongue or lips and nasal bleeding are intraoperative complications (22). Inexperienced staff and/or inadequate machines and equipment may lead to adverse events (32). To maintain skills and minimize the risk of adverse events or optimally eliminate it, it is needed to follow guidelines and participate in standard and regular training courses.

3.14. Team Work

During comprehensive dental rehabilitation using GA, an effective teamwork is the key to carrying out optimal dental services. Trained, experienced and skilled individuals in operation team are critical to avoid any risk and at the same time provide the most suitable and high quality care. The existence of dedicated assistance in anesthesia and also dental nurse with recognized training in their roles is required (17). Maintaining physiologic functions and adequate breathing of the child patient undergoing GA is the role of dental anesthesiologist and their assistants. The specialist continuously checks vital signs during operation.

On the completion of operation, the child must be recovered until consciousness returns. In the recovery the patient should be monitored carefully (17). Furthermore, some patients with certain medical problems should be managed with a pediatric team including pediatrician.

It is for a long time that pedodontists, besides performing conventional treatment by applying behavior management techniques, are specially trained to do treatment under GA. In this regard, emphasis is placed on the importance of delivering the most durable and successful treatments to avoid another GA and providing the child with high oral health-related quality of life.

3.15. Discharge

Fitness for discharge should be evidenced. Dental practitioner, the anesthetist and the recovery staff work in collaboration to permit the child's discharge (17). Child patients who appear oriented, alert and stable are ready to be discharged. Upon discharge, the patient is accompanied by a legally competent adult who has become aware of postoperative instructions (17).

3.16. Postoperative Discomfort in Children Undergoing Dental Treatment Using GA

Most of pediatric patients report complaints following dental GA procedure in different severity (23). Dental pain, difficulty in eating, nasal bleeding, throat discomfort, nose discomfort, sleep alteration, weakness, drowsiness, dehydration, fever, nausea, vomiting, hoarseness, diarrhea and constipation are several reported postoperative discomforts (8, 23). Post-operative pain is the most common complaint reported (23). In one study, 8.2% of the child patients undergone dental GA showed some postoperative complications (33). Enever et al. reported the range of 44% of post-operative symptoms based on parents' reports (34).

Developing post-operative complaints may be related to factors such as type of treatment, duration of GA, traumatic intubation, double throat pack, pre-existing medical status, provider experience and use of local anesthetic (23). Comparing the impact of treatment procedure on post-operative pain, it has been reported that placing SSCs and tooth extraction are the most pain provoking procedures (8, 24). However, most of post-operative complaints resolved in a few days and recipients regained their routine and normal physical activity soon (23).

3.17. Postoperative Instructions

The child must be supervised for 24 hours by parents postoperatively (17). There is an organized post-operative instruction. Via this written instruction parents are informed about any experienced symptoms and the possible sequence of events specially during the first 24 hours post operatively as well as diet to be followed.

Parents should be recommended to give pain killings (Paracetamol or Ibuprofen) following discharge on the first 24 hours. A dose can be received as the child demonstrates clear liquid tolerance (17). Parents must be informed that there may be some oozing from the extraction sites and crowns during the first day after appointment.

Only indoor activities are allowed because the child's balance and coordination may take several hours to return to normal state. Moreover, a follow-up appointment is scheduled for postoperative evaluation. Parents should also be guided to bring their child for regular follow-up dental care. In the follow-up session, the pediatric dentist checks if the healing process is progressing normally.

3.18. Parental Attitudes

Attitude of parents regarding GA have changed over time in the favor of it. Nowadays, there is a shift toward increasing acceptability of GA in parental opinion (9). Parents perceive dental GA as a treatment method which positively affects children's quality of life (15, 23).

3.19. Influencing Factors on Parental Decision to Choose Dental Rehabilitation Using GA

The level of child's cooperation, the risks of GA modality, the cost of anesthetic and dental procedures and the psychological impact of GA on the child are factors influencing parental decision to choose GA for their child (3).

3.20. Preventive advices

It is important to provide more preventive advice for parents of patients who undergo comprehensive dental treatment using GA (22). Parents should receive sufficient information regarding home care preventive measures (15). In fact, without providing routine oral hygiene, which is the duty of parents or caregiver, the ideal outcome cannot be achieved from comprehensive GA dental treatment.

4. Conclusions

With a comprehensive general and oral examination and scheduling a correct treatment plan, the likelihood to repeat GA is highly decreased. Likewise, the optimal timing of procedure to avoid another dental GA procedure is suggested and highlighted.

Consultation with parents about the dental and anesthesia procedures should be served. Complete attention and supervision must be paid by parents to the child before GA and after discharge. It should be emphasized to parents the cleaner the mouth is kept; the likelihood of failure or need for retreatment will be less.

Dental GA personnel need to be familiar to psychological demands of the child patient. Moreover, to minimize or eliminate the risk of adverse accidents, it is important that anesthesiologist performs the procedures with caution.

The numbers of pediatric dental patients who need dental rehabilitation under GA are increasing. It is also found a trend in pedodontists towards performing dental treatment under GA. This increasing supply and demand is inherently associated with more risks and complications.

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References

1. Sari ME, Ozmen B, Koyuturk AE, Tokay U. A retrospective comparison of dental treatment under general anesthesia on children with and without mental disabilities. *Niger J Clin Pract*. 2014;**17**(3):361-5. doi:10.4103/1119-3077.130243. [PubMed:24714018]
2. Schroth RJ, Morey B. Providing timely dental treatment for

- young children under general anesthesia is a government priority. *J Can Dent Assoc*. 2007;**33**(3):241-3.
3. Lee JY, Vann WJ, Roberts MW. A cost analysis of treating pediatric dental patients using general anesthesia versus conscious sedation. *Anesth Prog*. 2001;**48**(3):82-8. [PubMed: 11724224]
 4. Lee PY, Chou MY, Chen YL, Chen LP, Wang CJ, Huang WH. Comprehensive dental treatment under general anesthesia in healthy and disabled children. *Chang Gung Med J*. 2009;**32**(6):636-42. [PubMed: 20035643]
 5. Thikkurissy S, Crawford B, Groner J, Stewart R, Smiley MK. Effect of passive smoke exposure on general anesthesia for pediatric dental patients. *Anesth Prog*. 2012;**59**(4):143-6. doi:10.2344/0003-3006-59.4.143. [PubMed: 23241036]
 6. Tsai CL, Tsai YL, Lin YT, Lin YT. A retrospective study of dental treatment under general anesthesia of children with or without a chronic illness and/or a disability. *Chang Gung Med J*. 2006;**29**(4):412-8. [PubMed: 17051840]
 7. American Academy on Pediatric Dentistry Ad Hoc Committee on Sedation and Anesthesia. American academy on pediatric dentistry council on clinical affairs: Policy on the use of deep sedation and general anesthesia in the pediatric dental office. *Pediatr Dent*. 2008-2009;**30**(Suppl 7):66-7.
 8. Cantekin K, Yildirim MD, Delikan E, Cetin S. Postoperative discomfort of dental rehabilitation under general anesthesia. *Pak J Med Sci*. 2014;**30**(4):784-8. [PubMed: 25097517]
 9. Forsyth AR, Seminario AL, Scott J, Berg J, Ivanova I, Lee H. General anesthesia time for pediatric dental cases. *Pediatr Dent*. 2012;**34**(5):129-35. [PubMed: 23211897]
 10. El Batawi HY. Effect of preoperative oral midazolam sedation on separation anxiety and emergence delirium among children undergoing dental treatment under general anesthesia. *J Int Soc Prev Community Dent*. 2015;**5**(2):88-94. doi: 10.4103/2231-0762.155728. [PubMed: 25992332]
 11. Ramazani N. Child dental neglect: a short review. *Int J High Risk Behav Addict*. 2014;**3**(4):e21861 doi: 10.5812/ijhrba.21861. [PubMed: 25741483]
 12. Ramazani N, Poureslami HR, Ahmadi R, Ramazani M. Early childhood caries and the role of pediatricians in its prevention. *Iran J Pediatr Soc*. 2010;**2**(2):47-52.
 13. Baghdadi ZD. Children's oral health-related quality of life and associated factors: Mid-term changes after dental treatment under general anesthesia. *J Clin Exp Dent*. 2015;**1**(7):e106-13.
 14. Jankauskiene B, Virtanen JI, Kubilius R, Narbutaite J. Treatment under dental general anesthesia among children younger than 6 years in Lithuania. *Medicina (Kaunas)*. 2013;**49**(9):403-8. [PubMed: 24589576]
 15. Jankauskiene B, Virtanen JI, Kubilius R, Narbutaite J. Oral health-related quality of life after dental general anaesthesia treatment among children: a follow-up study. *BMC Oral Health*. 2014;**14**:81. doi:10.1186/1472-6831-14-81. [PubMed: 24984901]
 16. Hosey MT, Donaldson AN, Huntington C, Lioffi C, Reynolds PA, Alharatani R, et al. Improving access to preparatory information for children undergoing general anaesthesia for tooth extraction and their families: study protocol for a Phase III randomized controlled trial. *Trials*. 2014;**15**:219. doi: 10.1186/1745-6215-15-219. [PubMed: 24919430]
 17. Malhotra N. General anaesthesia for dentistry. *Indian J Anaesth*. 2008;**52**(Suppl 5):725-37.
 18. Leake D, Leake R. Principles of general anesthesia for children. *Anesth Prog*. 1967;**14**(3):53-9. [PubMed: 4226574]
 19. Goodwin M, Pretty IA, Sanders C. A study of the provision of hospital based dental General Anaesthetic services for children in the North West of England: Part 2—the views and experience of families and dentists regarding service needs, treatment and prevention. *BMC Oral Health*. 2015;**15**:47. doi: 10.1186/s12903-015-0029-3. [PubMed: 25881325]
 20. Weddell JA, Jones JE. Hospital dental services for children and the use of general anesthesia. In: McDonald RE, Avery DR, Dean JA editors. *Dentistry for the child and adolescent*. 9th ed. St. Louis: Mosby Elsevier; 2011. pp. 277-95. doi:10.1016/b978-0-323-05724-0.50019-9.
 21. Nasr VG, Davis JM. Anesthetic use in newborn infants: the urgent need for rigorous evaluation. *Pediatr Res*. 2015;**78**(1):2-6. doi: 10.1038/pr.2015.58. [PubMed: 25790274]
 22. Eshghi A, Samani MJ, Najafi NF, Hajjahmadi M. Evaluation of efficacy of restorative dental treatment provided under general anesthesia at hospitalized pediatric dental patients of Isfahan. *Dent Res J*. 2012;**9**(4):478-82.
 23. Farsi N, Ba'akdah R, Boker A, Almushayt A. Postoperative complications of pediatric dental general anesthesia procedure provided in Jeddah hospitals, Saudi Arabia. *BMC Oral Health*. 2009;**9**:6. doi:10.1186/1472-6831-9-6. [PubMed: 19228406]
 24. Townsend JA, Hagan JL, Smiley M. Use of local anesthesia during dental rehabilitation with general anesthesia: a survey of dentist anesthesiologists. *Anesth Prog*. 2014;**61**(1):11-7. doi: 10.2344/0003-3006-61.1.11. [PubMed: 24697820]
 25. Atan S, Ashley P, Gilthorpe MS, Scheer B, Mason C, Roberts G. Morbidity following dental treatment of children under intubation general anaesthesia in a day-stay unit. *Int J Paediatr Dent*. 2004;**14**(1):9-16. [PubMed: 14706023]
 26. Sammons HM, Unsworth V, Gray C, Choonara I, Cherrill J, Quirke W. Randomized controlled trial of the intraligamental use of a local anaesthetic (lignocaine 2%) versus controls in paediatric tooth extraction. *Int J Paediatr Dent*. 2007;**17**(4):297-303. doi: 10.1111/j.1365-263X.2007.00832.x. [PubMed: 17559458]
 27. Needleman HL, Harpavat S, Wu S, Allred EN, Berde C. Postoperative pain and other sequelae of dental rehabilitations performed on children under general anesthesia. *Pediatr Dent*. 2008;**30**(2):111-21. [PubMed: 18481575]
 28. Townsend JA, Martin A, Hagan JL, Needleman H. The use of local anesthesia during dental rehabilitations: a survey of AAPD members. *Pediatr Dent*. 2013;**35**(5):422-5. [PubMed: 24290554]
 29. VanCleave AM, Jones JE, McGlothlin JD, Saxen MA, Sanders BJ, Walker LA. Factors involved in dental surgery fires: a review of the literature. *Anesth Prog*. 2014;**61**(1):21-5. doi: 10.2344/0003-3006-61.1.21. [PubMed: 24697822]
 30. Ramazani N, Ahmadi R, Daryaeian M. Oral and dental laser treatments for children: applications, advantages and considerations. *J Lasers Med Sci*. 2012;**3**(1):44-9.
 31. Tiku AM, Hegde RJ, Swain LA, Shah FR. To assess and create awareness among anesthetists regarding prevention and management of injuries to the teeth and their associated structures during general anesthesia. *J Indian Soc Pedod Prev Dent*. 2014;**32**(1):58-62. doi:10.4103/0970-4388.127059. [PubMed: 24531604]
 32. Lee HH, Milgrom P, Starks H, Burke W. Trends in death associated with pediatric dental sedation and general anesthesia. *Paediatr Anaesth*. 2013;**23**(8):741-6. doi: 10.1111/pan.12210. [PubMed: 23763673]
 33. Vinckier F, Gizani S, Declerck D. Comprehensive dental care for children with rampant caries under general anaesthesia. *Int J Paediatr Dent*. 2001;**11**(1):25-32. [PubMed: 11309869]
 34. Enever GR, Nunn JH, Sheehan JK. A comparison of post-operative morbidity following outpatient dental care under general anaesthesia in paediatric patients with and without disabilities. *Int J Paediatr Dent*. 2000;**10**(2):120-5. [PubMed: 11310096]