

Postoperative Complications Following Dental Treatment under General Anesthesia of Pediatric Patients: A Review

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ABSTRACT

Introduction: General anesthesia is an advanced behavior guidance technique indicated for some pediatric dental patients to provide a safe and high-quality dental treatment. However, systemic and dental risks following the treatment are questionable. No available reviews outline the complications following the dental treatment among pediatric patients and how to reduce its incidence afterward.

Aims: This review aimed to assess the reported postoperative complications among healthy pediatric patients (ASA I or II) following dental treatment under general anesthesia and recommendations to reduce the incidence and severity of these complications postoperatively.

Methods: A review of the literature on postoperative complications following dental treatment under general anesthesia was conducted. Published articles addressing the type, frequency, and severity of the postoperative complications among healthy pediatric dental patients were assessed.

Results: In general, the results of this review indicated that the complications are mild to moderate in severity and no severe complications were documented. Also, the majority can be easily managed and most importantly could be avoided before its occurrence.

Conclusion: This review helps to predict the most common complications following dental treatment of healthy pediatric patients under general anesthesia and recommendations to minimize the morbidity postoperatively.

Key words: General anesthesia, Pediatric, Complications, Postoperative, Dental treatment

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INTRODUCTION

In pediatric dentistry, advanced behavior guidance technique sometimes is the best treatment strategy for patients who has severe disruptive behavior or who lack cooperative ability due to psychological, physical, or medical disorders. Indicated also to obtain good pain control when local anesthesia cannot be achieved. And in cases, advanced and comprehensive surgical or dental treatment is required. General

anesthesia is advantageous also for providing safe and high-quality dental treatment. At the same time, eliminate the pain, child reaction with the dental treatment, and maintain the psychological health of the child [1].

On the other hand, providing dental treatment under general anesthesia includes some risks. And many studies were done to evaluate the safety of providing dental treatment under general anesthesia. In general, the reported postoperative complications are mild to moderate in severity and it does not require hospitalization for further management [2-5]. However, severe complications and death are very rare, especially among healthy children [6]. Mortality risk among pediatric dental patients assessed over a period of 10 years and more

than 22,000 cases, the results confirmed that the dental treatment can be safely provided under general anesthesia since there were no deaths reported [7].

Previous studies had reported different types and numbers of dental procedures that are associated with postoperative discomfort. One study found that early discomfort in young children after general anesthesia was related to the placement of space maintainers and crowns but not associated with the extractions [8]. Mayeda and Wilson concluded that the placement of stainless steel crowns was related to the most severe complaint [9]. In some studies, extraction was the most dental procedure that is likely to cause pain postoperatively [10-13]. On the other hand, there was no association between the performed dental treatment and the postoperative discomfort in other reports [4,5].

The range and type of complications among the previous studies are variable due to the different study designs, measures, age and number of participants, recording time of complaints, confounding variables and statistics used, procedure complexity and duration, using of local anesthesia, an analgesic used intraoperatively at the end of the procedure or in the recovery room, and the overall differences in general anesthesia protocol used. Some studies reported the complaints immediately postoperative, others reported within 24 to 72 hours. The overall reported morbidities after treatment under general anesthesia of physically and mentally healthy pediatric dental patient ranges from 5% and up to 94.86% [3,4,9,11,14,15]. Generally, the frequency and severity of the complications are usually within the first 24 hours postoperatively, and then it reduced significantly after 72 hours [4,16].

Factors that were associated with postoperative complications include but are not limited to: age of the patient, medical status, provided dental treatment, provider experience, premedication used, total anesthetic time, intubation difficulty, and anesthetic agents used [2,16-21]. Previous studies found a relationship between preoperative dental anxiety with the postoperative morbidity. Children with increased dental anxiety tend to have more adverse events postoperatively [14,22]. In addition, Costa et al. had evaluated the factors that could be

related to the postoperative discomfort in young children, they found that the discomfort was mild and only of short duration after dental treatment under general anesthesia. This might be due to the use of intraoperative analgesia in their study. Factors that were found to be associated with the discomfort were; children who reported more discomfort preoperatively tend to have more discomfort after the treatment, it is most likely because the more invasive dental procedures are usually performed in a patient with a higher dental discomfort questionnaire score (DDQ-8). Another important factor that is reported in this study was the sleep length in the recovery room, children who slept longer time postoperatively feel more comfortable compared to those who slept shorter times. And finally, those who returned to a normal diet on the same day of the surgery reported fewer discomfort scores postoperatively [8].

All the possible postoperative morbidities should be explained clearly to the patient's parents or caregivers before the procedure and how to deal with these complications if it happens. The American Society of Anesthesiologists recommends periodic assessment and monitoring of the patient postoperatively. Including evaluation of vital signs along with temperature, pain, nausea and vomiting, bleeding, and hydration. And this is beneficial for the early detection of complications and reduces the possibility of adverse outcomes [23]. Up to date, few studies recorded the complications after treatment under general anesthesia and no review article was done previously to outline the most common complications observed among pediatric dental patients. This is beneficial for predicting the common complaints and to find ways to prevent or at least to reduce its occurrence.

Therefore, this review was undertaken to assess the reported postoperative complications among healthy pediatric patients (ASA I or II) following dental treatment under general anesthesia and recommendations to reduce the incidence and severity of these complications postoperatively.

MOST COMMON COMPLICATIONS

Dental pain

Post-operative pain was the most frequently reported complaint following dental treatment

under general anesthesia and the longest complaint reported by the patients [2,3,5,10]. The reported incidence of dental pain in the previous studies ranges from 0% to 95%.

It is not associated with the type of dental treatment provided but was significantly associated with the total number of teeth treated [5]. Atan et al. also found that the number of surgical procedures was significantly associated with postoperative pain (OR = 1.37). But, by using local anesthesia intraoperatively, the odds were reduced (OR = 0.59) [2]. A recent study reported the same factor which is the use of local anesthesia reduced the postoperative frequency of pain [5].

The number of extracted teeth had affected the postoperative pain by that, children with 7-10 extractions had significantly increased in pain score compared to those with 1-6 extracted teeth [19]. This is similar to the previous studies, the type and number of the procedure had affected the incidence and severity of postoperative pain, children with the increased number of extracted teeth were more likely to feel pain postoperatively [10-13].

On the other hand, Erkmen Almaz et al. concluded that the postoperative dental pain was not related to the type of the dental treatment nor with the number of overall treated teeth [4]. And in the Chelliah study, the majority of the patients had only mild pain or no pain at all after teeth extractions even no analgesics were required [24]. Despite the comprehensive dental treatment performed in the Vinckier et al. study, none of their children complaint of pain postoperatively. This could be attributed to the administration of intraoperative analgesia at the end of the procedure and this is similar to the Jensen study where despite the extraction of the primary and permanent teeth, the reported pain was very low [15,25].

The highest recorded pain was immediately or within 24 hours postoperatively and then was subsided gradually [4,10,26]. Zhang et al. revealed that the risk factor that increased the postoperative pain was the operation duration. This could be attributed to the complexity of the procure as the duration increased [3]. In addition, Needleman et al. found other risk factors that increased the incidence of pain in children aged 4 years or older; the dental procedure included

extractions, the total number of the procedure was 12 or more, and traumatic intubation. Children who had traumatic intubation were reported to experience more pain postoperatively [10]. Also, the adult who is accompanying the child had significantly affected the pain reporting in that the complaint of pain was higher if the mother attended to his/her child [12]. In addition, those who were anesthetized with sevoflurane complained of more pain compared to those anesthetized with halothane [18]. Parent education and socioeconomic status (SES) had affected the pain reporting in that parents who are less educated or have low SES were more likely to report pain [10,27,28].

A randomized controlled trial conducted to assess postoperative pain by using local anesthesia intraoperatively, found that the pain scores were not significantly different between the treatment group and the control group and it was not effective in reducing the pain nor distress among the pediatric patients. Even though the analgesic (acetaminophen elixir) was administered preoperatively for both groups. Also, the requirement of postoperative analgesia did not make a difference between the two groups. On the other hand, the administration of local anesthesia causes trauma to the lips and cheek due to the altered sensation. But, only three patients in the local anesthesia group reported these injuries [19].

Local anesthesia is usually used for pain management, to reduce the bleeding after tooth extraction, and to control the physiological response by reducing the anesthetic agents used. A systematic review was done to assess whether using local anesthesia intraoperatively will reduce pain postoperatively following dental treatment among pediatric patients and adolescents. The evidence was inconclusive regarding the significant benefit of using local anesthesia. Further randomized controlled trials are needed [29].

Monessali, et al. in a recent randomized controlled trial among different subgroups of children who underwent restorative dental treatment with and without extractions under general anesthesia found that there was no significant benefit of administering intraoperative local anesthesia between the subgroups on postoperative pain using a universal pain assessment tool and for each patient seven pain scores were recorded.

However, postoperative bleeding was not assessed in their study [30].

The drawbacks of using local anesthesia in young children along with the numbness sensation that can increase postoperative distress did not reduce the pain postoperatively despite the use of preoperative analgesics (paracetamol and NSAIDs). However, the administration of local anesthesia manifests its role in controlling postoperative bleeding [31].

The reported pain complaints among the studies are variable due to the differences in patient's age, provided dental treatment, use of local anesthesia intraoperatively, pain scales used, and analgesics are given at the end of the procedure. Self-report of pain is the best pain assessment method [32,33]. However, pain assessment in the pediatric patient is difficult, and there is no best assessment tool that best describes the pain the child is feeling [34]. So the reported pain was mostly by the patient's parents or nurses not by the patient itself which can result in over or underestimation of the child's pain.

Bleeding

In healthy pediatric patients, blood loss following dental extraction under general anesthesia can be affected by several factors, including the number of extractions, root resorption, presence of infection, socket size, and surgical procedure used for the extraction [35]. The estimated total blood loss following teeth extraction ranged from 2.5 up to 57mL [36].

Bleeding was significantly higher in patients with an increased number of extracted teeth [5,19,36-38]. However, other studies reported no association between postoperative dental bleeding and the number of extracted teeth [3,4]. And this could be related to the vasoconstrictor within the local anesthesia given intraoperatively and packing of the alveolar socket. In some cases, hospital admission is needed to control the bleeding following dental extractions [39].

Many techniques are documented to minimize the postoperative bleeding, such as absorbable hemostatic packs, suturing, local anesthesia, contained vasoconstrictor, and pressure packs in the surgical site [40]. In a pilot study, the placing of absorbable hemostatic packs had a significant advantage in minimizing the bleeding following the dental extraction procedure [35].

Another rare cause of bleeding after dental rehabilitation under general anesthesia is stainless steel crown (SSC). There were documented cases of two patients presented to the emergency department after 12 hours of the dental treatment with a chief complaint of persistent moderate gingival bleeding around tooth restored with SSC. In both cases, the bleeding could be related to traumatized soft tissues subsequent to tooth preparation and cementation of the crown. In the first case, the bleeding was also related to the residual cement in the sulcus and managed by removing the cement along with local measures including gauze pressure, placement of resorbable mesh, and application of ferric sulfate. In the second case, in addition to the bleeding that was observed persistent from the sulcus, there was lacerated palatal tissue around the crown [41].

Sore throat

The incidence of sore throat following dental treatment was very low in one study (7.9%) [3]. However, others reported that more than 20% of the pediatric patients complained of a sore throat within the first 24 hours postoperatively [4,10,11,16,42]. This complaint is most likely related to the traumatic intubation technique [10,37].

Fever

Previous studies reported the range of fever from 9% up to 45% [3,4,42-44]. There are many factors that could increase the incidence of fever following the treatment under general anesthesia, including but not limited to: dehydration, bacteremia, increase the temperature of the operating room, some medications, and soft tissue destruction [3,43]. Dehydration and low nutritional status were significant factors of the development of fever after general anesthesia [3,45].

Psychological changes

The percentage of psychological changes within 24 hours was (24.1%). However, after 72 hours the reported psychological changes were reduced significantly to (14.3%) [4]. These changes might be related to the anesthetic agent used. Sevoflurane was associated with more behavioral changes in children than those anesthetized with halothane [18,46,47]. The behavioral changes could be attributed to the procedure used to anesthetize the child who is extremely anxious in the dental clinic.

A systematic review that compares the effects of sevoflurane with other general anesthetic agents found that children who were anesthetized with sevoflurane were more agitated [48]. Agitation in healthy children was reported in some studies, it ranges from 26% to 76% following dental general anesthesia [3,10].

The feeling of irritability could be attributed to many reasons as reported by Hu et al., such as the new environment to the child, long-term fasting, and parent separation [5]. In addition, one of the significant factors related to post-hospitalization anxiety is child separation from the parent during the anesthesia induction [49].

Other complications

Sleepiness, nausea, weakness, and dizziness were all reported to be associated with general anesthetic time, duration, patient gender, and use of local anesthesia [2].

The procedure duration was the factor associated with postoperative drowsiness and sleepiness as shown in the previous studies [2,3,10]. Others found a relation between some types of anesthetic agents (sevoflurane and Propofol) and the incidence of nausea, vomiting, and drowsiness [50,51]. After 72 hours of the postoperative period, these complaints were reduced significantly [4,37].

The feeling of sleepiness was most commonly reported 1 h after the procedure under general anesthesia (84%), and the documented sleepiness in the previous studies ranged from 43% up to 84% [2,3,10, 14,16].

Dizziness complaint postoperatively was 3 times higher (OR = 3•14) if the local anesthetic was given during the procedure [2]. Also, Zhang et al. found that the patients who received local anesthesia were more likely to feel drowsy postoperatively [3].

In a study conducted on 200 dental cases among pediatric patients treated under general anesthesia, vomiting was the most common complication in a patient younger than five years of age [42]. The incidence of postoperative nausea and vomiting (PONV) was strongly associated with the type of surgery performed [52]. However, there is a dentally related factor that might also increase the incidence, which is the dental procedure provided to the patient. Extraction cases result in more postoperative

vomiting and this is related to the swallowing of the blood after dental extractions [53]. On the other hand, the anesthetic most important factor is the use of volatile anesthetic gases [54]. Using opioids analgesics intra- or postoperatively, intake of oral food or fluids pre- or immediately postoperatively, and patients who have a high predisposition to PONV are other reported factors [10,55-59]. So, dental procedures under general anesthesia should be considered to have a high emetic risk postoperatively and the patient should receive prophylactic antiemetic drugs [60].

Other documented minor reversible complications were also reported and commonly observed include swelling in the oral or perioral area and iatrogenic trauma (such as minor abrasion, burns, or laceration of the oral soft tissues). Within 2 weeks following the completion of the procedure, these complaints most probably will resolve without intervention [49].

Intubation type

Intubation type and technique had been reported to have a role in the side effects after dental treatment under general anesthesia.

Intubation with endotracheal tubes (oral or nasotracheal) could lead to many morbidities following the general anesthesia. Including laryngeal pain, voice changes (hoarseness), nausea, and vomiting postoperatively [61]. Even the incidence of emergence delirium was higher in children intubated with endotracheal intubation (20%) than those intubated with laryngeal mask airway (8%) [62].

The nasotracheal intubation is more traumatic to the soft tissues than the orotracheal [63,64]. In a four years review study of the complications associated with nasotracheal intubation the reported complications were common especially among young children [65]. Sore throat, coughing, and epistaxis are associated with stimulation or traumatization of the respiratory tract's mucosa. Traumatic nasotracheal intubation was associated with more reports of pain and sore throat in a Needleman et al. study [10,66,67]. On the other hand, its advantage is easier accessibility to the oral cavity in comparison to oral intubation [64,68].

Epistaxis was reported to be low as 7.8% up to 12.8% following dental general anesthesia

[3,11]. And bacteremia has been reported to be the reason for nasal bleeding [69,70]. The incidence of bacteremia was more likely to occur with the nasotracheal intubation compared to the orotracheal [14,71,72].

Laryngeal mask airway is a suggested alternative to endotracheal intubation because it has a lower risk of traumatizing the upper respiratory tract and lower incidence of overall postoperative morbidities [61,73]. A prospective randomized control trial was done to assess the differences between nasotracheal intubation and laryngeal mask airway in a group of pediatric patients undergoing dental rehabilitation under general anesthesia, the results showed that the laryngeal mask airway was less traumatic, results in significantly less laryngeal pain postoperatively (8.5%) compared to nasotracheal intubation group (97.2%), and after 6 hours none of the children intubated with laryngeal mask airway complained of a laryngeal pain. Moreover, a significant reduction was reported with regarding to emergence delirium and recovery time in children intubated with laryngeal mask airway [73]. In addition, the soft tissue trauma postoperatively as a consequence of the intubation in children was very low in laryngeal mask airway compared to the endotracheal intubation group (10%) [74]. In a systematic review, the documented incidence of sore throat was (21.5%) in the laryngeal mask airway and (34.3%) for the endotracheal intubated patients [75].

**Recommendations to reduce the incidence of the postoperative complications:
[5,8,10,26,35,40,45,49,60,73]**

- ✓ The presence of the parent during induction of general anesthesia in the operating room might reduce the incidence of separation anxiety in the postoperative period.
- ✓ Laryngeal mask airway can be an alternative to endotracheal intubation in pediatric dental procedures.
- ✓ Using intraoperative prophylactic antiemetic agents (such as dexamethasone or ondansetron) to reduce the incidence of postoperative nausea and vomiting.
- ✓ Intraoperative use of local anesthesia might be helpful to minimize the anesthetic requirements, provide some postoperative analgesia, and most importantly help in controlling the postoperative bleeding.

- ✓ Teeth extraction prioritization should be considered in high emetic risk patients or ensuring of bleeding controlled before the extubation to reduce the chance of postoperative nausea and vomiting as a consequence of blood swallowing.
- ✓ Placing of resorbable hemostatic packs in the socket and/or sutures after extraction or any other surgical procedures can be used to minimize the bleeding.
- ✓ Gentle manipulation of soft tissues during tooth preparation and ensure removal of excess cement after crown cementation.
- ✓ Intraoperative Administration of intravenous analgesics such as the nonsteroidal anti-inflammatory agent, ketorolac, given 30 min before the termination of the procedure can also provide significant postoperative analgesia.
- ✓ Monitoring of the vital signs; initially it needs to be documented every 5-minutes, and then every 10-15 minutes in an alert child.
- ✓ Applying gauze packs for hemostasis immediately in postoperative periods.
- ✓ Optimal hydration to reduce the incidence of fever.
- ✓ Using ice chips for sore throat and acetaminophen for fever.
- ✓ Pain control agents should be prescribed and given as prophylaxis in the first few days postoperatively instead of recommending as needed "PRN" analgesics (e.g. acetaminophen alone or with hydrocodone, or nonsteroidal anti-inflammatory agents).

CONCLUSION

Generally, the benefits of comprehensive dental treatment of healthy pediatric patients under general anesthesia outweigh its risks. The reported complications are considered to be mild to moderate in severity and it can be managed without hospitalization. Writing all the possible complaints in the informed consent and discussing them with the patient's parent is critical. Following the recommendations outlined in this review could reduce the severity of the complaint in the postoperative period.

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