



Techniques for Induction of General Anaesthesia in Pediatric Dental Patients: A Review

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ABSTRACT

The induction of general anesthesia in pediatric dental patients requires special consideration due to their unique physiological and psychological characteristics. This comprehensive review article aims to provide an overview of various techniques employed for the induction of general anesthesia in pediatric dental patients. We discuss the importance of preoperative evaluation, patient preparation, and selection of appropriate anaesthetic agents and equipment. Additionally, we explore the advantages, disadvantages, and considerations associated with different induction techniques, including inhalation induction, intravenous induction, and newer modalities such as intranasal and transmucosal drug delivery. Furthermore, we address the specific challenges encountered during the induction process, including parental separation anxiety, fear and anxiety management, and the use of adjunctive techniques to facilitate a smooth and successful induction. By providing a comprehensive analysis of induction techniques, this review aims to enhance the knowledge and clinical practice of dental professionals involved in pediatric anesthesia.

Keywords: Pediatric Dentistry, General Anesthesia, Induction Techniques, Inhalation Induction, Intravenous Induction, Intranasal Drug Delivery, Transmucosal Drug Delivery, Fear and Anxiety Management.

INTRODUCTION

The use of general anesthesia in pediatric dental patients is justified in several situations to ensure the provision of safe, effective, and efficient dental care. Pediatric patients, particularly those in the younger age groups, often exhibit high levels of anxiety, fear, and lack of cooperation during dental procedures. This can impede the dentist's ability to perform necessary treatments and may compromise the safety and quality of care. General anesthesia allows for deep sedation or unconsciousness, enabling the dental team to perform the required dental procedures while ensuring patient comfort and cooperation. Invasive and Extensive Procedures: Some dental procedures, such as tooth extractions, restorative work on multiple teeth, or complex oral surgeries, necessitate a relaxed patient and a controlled environment. General anesthesia provides profound muscle relaxation, facilitating the execution of intricate and invasive dental treatments without causing patient discomfort or movement. Special Needs Patients: Pediatric patients with special needs, such as developmental disabilities or physical impairments, often require extensive dental interventions. Pediatric dental anesthesia requires careful consideration of the unique physiological and psychological characteristics of children. Children undergo significant physiological changes as they grow and develop. Factors such as body size, metabolism, respiratory function, and cardiovascular stability differ among different age groups. Parents or guardians play a crucial role in pediatric dental anesthesia. Addressing parental concerns, providing clear communication, and involving them in the preoperative preparation and postoperative care contribute to the overall success of the anesthesia experience. Strategies for parental separation anxiety management and effective communication are essential components of pediatric dental anesthesia practice. By recognizing these unique considerations and tailoring anesthesia techniques to suit pediatric dental patients, dental professionals can provide optimal care, ensure patient comfort, and achieve successful treatment outcomes.¹⁻³

Preoperative Evaluation and Patient Preparation in Pediatric Dental Anesthesia:

Preoperative evaluation and patient preparation are vital components of pediatric dental anesthesia to ensure the safety and success of the anesthesia experience. This involves a thorough assessment of the patient's medical history, physical examination, and psychological considerations.⁴The following aspects should be considered during the preoperative evaluation and patient preparation process:

1. Medical History Assessment:

Obtain a detailed medical history, including any underlying medical conditions, previous surgeries, allergies, and medications the child is currently taking. Pay special attention to conditions such as cardiovascular disorders, respiratory diseases, bleeding disorders, and any syndromes or developmental

disabilities that may impact anesthesia management. Evaluate any history of adverse reactions to anesthesia or family history of anesthesia-related complications.

2. Risk Stratification:

Evaluate the patient's overall health status and assess the potential risks associated with anesthesia and dental procedures. Stratify the patient's risk based on their medical history, physical examination findings, and any relevant laboratory investigations. Consult with the patient's primary care physician or specialist if needed to optimize the patient's medical condition before the anesthesia procedure.

3. Physical Examination:

Perform a thorough physical examination, including assessment of the airway, heart, lungs, and other relevant systems. Evaluate the patient's baseline vital signs, including heart rate, blood pressure, respiratory rate, and oxygen saturation. Identify any anatomical or physiological factors that may impact airway management, such as tonsillar hypertrophy, craniofacial abnormalities, or restricted neck mobility.

4. Laboratory Investigations:

Order appropriate laboratory investigations based on the patient's medical history and risk stratification. Common laboratory tests may include complete blood count (CBC), coagulation profile, renal and hepatic function tests, and any specific tests relevant to the patient's underlying medical condition. Ensure that laboratory results are available and reviewed prior to the anesthesia procedure.

5. NPO Guidelines and Fasting Recommendations:

Adhere to the guidelines for preoperative fasting to minimize the risk of aspiration during induction and maintenance of anesthesia. Communicate clear fasting instructions to the patient's parents or caregivers, including guidelines for fasting duration based on age, type of food or drink, and specific procedure requirements. Consider the patient's age, medical condition, and the type of procedure when determining the appropriate fasting duration.

6. Psychological Preparation:

Assess the child's psychological state and address any fears or anxieties associated with the dental procedure and anesthesia experience. Utilize child-friendly language and explanations to educate the child about the anesthesia process and what to expect. Involve the parents or caregivers in the preoperative preparation process to provide comfort and support to the child. Consider the use of age-appropriate distraction techniques, such as toys, books, or videos, to help alleviate anxiety.

7. Informed Consent:

Obtain informed consent from the parent or legal guardian before proceeding with the anesthesia procedure. Clearly communicate the risks, benefits, and alternatives of the anesthesia technique and obtain written consent. Ensure that the parent or legal guardian understands the procedure, including potential risks and postoperative care instructions.

Selection of Anesthetic Agents and Equipment in Pediatric Dental Anesthesia:

The selection of appropriate anesthetic agents and equipment is crucial in pediatric dental anesthesia to ensure safe and effective anesthesia induction, maintenance, and emergence. Considerations should be given to the specific needs and characteristics of pediatric patients. The following factors should be taken into account when selecting anesthetic agents and equipment⁴:

1. Inhalational Anesthetics:

Inhalational anesthetics such as sevoflurane and desflurane are commonly used in pediatric dental anesthesia. These agents offer rapid induction and emergence, good titratability, and minimal side effects. Select an inhalational agent based on factors such as the child's age, airway characteristics, procedure duration, and the equipment available.

2. Intravenous Induction Agents:

Intravenous (IV) induction agents, such as propofol and etomidate, are used for a controlled and smooth induction of anesthesia in pediatric patients. Factors to consider when choosing an IV induction agent include the child's age, medical condition, anticipated duration of the procedure, and potential side effects. Ensure appropriate dosing based on the child's weight and age, taking into consideration any comorbidities or drug interactions.

3. Analgesics and Adjunct Medications:

Selection of analgesics should be based on the child's age, procedural pain intensity, and anticipated duration of postoperative pain control required. Commonly used analgesics in pediatric dental anesthesia include opioids (e.g., fentanyl), nonsteroidal anti-inflammatory drugs (NSAIDs), and local anesthetics. Adjunct medications such as antiemetics and antihistamines may be needed to prevent nausea, vomiting, and allergic reactions.

4. Neuromuscular Blocking Agents:

Neuromuscular blocking agents (NMBAs) may be required for certain dental procedures that necessitate muscle relaxation and a motionless patient. Use NMBAs judiciously, considering the age, weight, and underlying medical conditions of the child. Monitoring of neuromuscular function with train-of-four (TOF) monitoring is essential to guide the dosing and titration of NMBAs.

5. Monitoring Equipment:

Use appropriate monitoring equipment to ensure patient safety during anesthesia. Essential monitoring includes pulse oximetry, capnography, electrocardiography (ECG), non-invasive blood pressure (NIBP) monitoring, and temperature monitoring. Pediatric-specific monitors and appropriate sizes of blood pressure cuffs, ECG electrodes, and pulse oximeter probes should be available.

6. Airway Management Equipment:

Pediatric airway management requires specialized equipment due to the unique anatomical considerations. Selection of appropriate-sized face masks, laryngoscopes, endotracheal tubes, supraglottic airway devices (e.g., laryngeal mask airway), and oral airways is crucial. Have access to equipment for difficult airway management, such as fiberoptic bronchoscopes and video laryngoscopes, in case of unanticipated difficulties.

7. Emergency Medications and Equipment:

Ensure availability of emergency medications and equipment, including resuscitation drugs, defibrillator, suction devices, and intubation equipment, in case of any unforeseen complications or emergencies.

8. Patient-Specific Considerations:

Tailor the selection of anesthetic agents and equipment based on the child's individual characteristics, including age, weight, medical history, and any specific needs or conditions. Take into account any known allergies or sensitivities to certain medications or anesthetic agents.

Agents used in pediatric dentistry

1. Induction Agents:

Propofol: Often used for its rapid onset and short duration of action, providing a smooth induction process for pediatric patients.

Sevoflurane: An inhalation agent commonly used for mask induction in pediatric patients due to its pleasant odor, rapid onset, and smooth induction.

2. Inhalation Agents:

Sevoflurane: In addition to its use for mask induction, sevoflurane can be used to maintain general anesthesia during dental procedures in pediatric patients.

Nitrous Oxide: Commonly used as an adjunct to other agents for mild sedation and analgesia during dental procedures. It is often administered in combination with oxygen through a nasal mask.

3. Opioids:

- Fentanyl: A potent opioid analgesic used for intraoperative and postoperative pain control in pediatric dental patients.

Remifentanyl: An ultra-short-acting opioid that allows for precise titration of analgesia during dental procedures.

4. Local Anesthetics:

Lidocaine: Used for local anesthesia to provide pain control during dental procedures. It may be administered topically or via infiltration or nerve blocks.

5. Adjunct Agents:

Benzodiazepines (e.g., midazolam): Used as premedication to reduce anxiety and promote sedation before the induction of general anesthesia.

Antiemetics (e.g., ondansetron): Administered to prevent and treat postoperative nausea and vomiting in pediatric dental patients.

Inhalation Induction in Pediatric Dental Anesthesia:

Inhalation induction is a commonly employed technique in pediatric dental anesthesia due to its ease of administration, rapid onset of action, and ability to provide a smooth and controlled induction process. It involves the inhalation of anesthetic gases or volatile agents to induce a state of sedation or general anesthesia. Inhalation induction can be achieved through various methods, including mask induction techniques and the use of nitrous oxide/oxygen inhalation. Mask induction is a popular method for inhalation induction in pediatric dental patients, particularly in younger children or those with dental anxiety. The child is typically positioned in a semi-reclined or supine position and instructed to breathe through a mask connected to a breathing circuit or a bag-valve-mask system. Anesthetic gases, such as sevoflurane or desflurane, are administered via the mask, allowing the child to inhale the agents and gradually enter a sedated or anesthetic state. The concentration of the anesthetic gases can be titrated to achieve the desired level of

sedation or anesthesia. Advantages of mask induction include ease of administration, patient cooperation, and a smooth transition from awake to anesthetized. Prior to mask induction, premedication may be administered to alleviate anxiety and facilitate a smoother induction process. Commonly used premedication agents include oral midazolam or other benzodiazepines, which have sedative, anxiolytic, and amnesic properties. The premedication dosage should be carefully determined based on the child's age, weight, and medical condition, and administered at an appropriate time before the procedure. Sedation achieved through premedication helps reduce fear and anxiety, making the mask induction process more comfortable for the child. Nitrous oxide (N₂O), also known as "laughing gas," is frequently utilized in pediatric dental anesthesia. Nitrous oxide/oxygen inhalation sedation involves the administration of a mixture of nitrous oxide and oxygen via a nasal mask or nasal hood. The nitrous oxide concentration can be gradually increased to achieve the desired level of sedation, while maintaining adequate oxygenation with the oxygen component. Nitrous oxide provides analgesic and anxiolytic effects, helping to alleviate pain and anxiety during dental procedures. Nitrous oxide/oxygen inhalation is particularly useful for mild to moderate sedation, as it allows for rapid onset and offset of sedation, easy titration, and a short recovery period.^{8,9}

Considerations and Techniques for Inhalation Induction:

Continuous monitoring of vital signs, including pulse oximetry, capnography, and blood pressure, should be performed throughout the inhalation induction process. Monitoring equipment should be appropriately sized for pediatric patients and easily visible to the anesthesia provider. Careful airway assessment is essential before inhalation induction to identify any anatomical factors that may impact mask fit or airway patency. Proper mask fit and a good seal are crucial for effective delivery of anesthetic gases and preventing leaks. Consider the use of airway adjuncts such as oral airways to maintain airway patency during mask induction. Parental presence and involvement can help alleviate anxiety in pediatric patients during inhalation induction. Parents should be educated about the induction process, reassured about the safety measures in place, and encouraged to provide emotional support to the child.¹⁰

Intravenous Induction in Pediatric Dental Anesthesia:

Intravenous (IV) induction is another commonly used technique in pediatric dental anesthesia for achieving rapid and controlled sedation or general anesthesia. It involves the administration of anesthetic agents directly into the bloodstream, resulting in a rapid onset of action. IV induction is typically preferred for older children or those who may not tolerate mask induction. Ensure appropriate fasting guidelines are followed to minimize the risk of aspiration. Establish IV access before the induction process begins. This may involve using a peripheral intravenous line, a scalp vein, or an intraosseous route, depending on the patient's age, condition, and venous access availability. Select appropriate IV induction agents based on the child's age, weight, medical condition, and the desired depth of sedation or anesthesia. Commonly used induction agents in pediatric dental anesthesia include propofol, etomidate, and ketamine. Calculate the appropriate dosage of the selected induction agent based on the child's weight, age, and specific requirement. Titrate the induction agent dose carefully, considering the child's response, desired depth of sedation, and any comorbidities. Continuously monitor vital signs, including heart rate, blood pressure, oxygen saturation, and ECG, throughout the induction process. Effective communication and reassurance play a crucial role in the success of IV induction in pediatric dental patients. Intranasal and transmucosal drug delivery are non-invasive routes that offer an alternative method for delivering medications in pediatric dental anesthesia. These routes provide several advantages, including ease of administration, rapid absorption, avoidance of gastrointestinal breakdown, and reduced discomfort for the child. Intranasal and transmucosal drug delivery provides a valuable option in pediatric dental anesthesia for achieving rapid sedation, analgesia, or anxiolysis. Proper selection of medications, dosages, and administration techniques, along with vigilant monitoring, can enhance the safety and effectiveness of these routes of drug delivery.^{4, 11-15}

Conclusion

By employing appropriate techniques and utilizing a multidisciplinary approach, dental professionals, anesthesiologists, and other healthcare providers can ensure successful and safe induction of general anesthesia in pediatric dental patients, facilitating the delivery of necessary dental treatments while ensuring patient comfort and well-being. Continuous advancements in anesthetic techniques and equipment further contribute to improving the overall experience and outcomes for pediatric dental patients undergoing general anesthesia.

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