# SEDATION AND LARYNGOSPASM IN PEDIATRIC SURGERY: A SYSTEMATIC REVIEW

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**Abstract**: Introduction: The use of anesthetics in pediatrics is essential for diagnostic and therapeutic procedures. The incidence of post-anesthetic respiratory complications is often avoidable with appropriate intervention. Laryngospasm, a reflex obstruction of the vocal cords, is more common in children. Objective: To discuss respiratory complications, with an emphasis on laryngospasm, during the use of anesthetics in pediatric procedures. Method: The Medical Literature Analysis and Retrieval System Online (MEDLINE, via PUBMED), Latin American and Caribbean Health Sciences Literature (LILACS), Scientific Electronic Library Online (SciELO), and Virtual Health Library (VHL) databases were used. Seven articles were selected that met the systematic review criteria. Results: The incidence of laryngospasm is 0.87% in adults, 1.7% in children, and 2.82% in babies. In children, it occurs mainly during emergence from anesthesia. Risk factors include inadequate anesthesia, respiratory infections and multiple attempts at airway management. Drug combinations such as propofol, ketamine and fentanyl are used to minimize complications. Preventive measures include clearing secretions and adequate depth of anesthesia. Drugs such β2-adrenergic agonists, such as albuterol, are used to reduce respiratory resistance during intubation. Training strategies with low-cost simulators are effective for managing difficult airways in pediatrics. In pediatric surgery, the laryngeal mask is preferred to endotracheal

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intubation to reduce respiratory complications. Studies indicate that positive communication between anesthesia teams improves performance in critical situations. Conclusion: Laryngospasm is a serious complication in pediatric anesthesia, more common in children due to their anatomy and sensitive reflexes. Risk factors include respiratory infections, asthma, smoking, gastroesophageal reflux, and superficial anesthesia. Prevention involves the proper use of anesthetics, cleaning secretions and careful monitoring. Medications such as propofol, ketamine, and albuterol can reduce adverse effects. Simulator training and effective communication in anesthesia teams improve clinical performance. With proper management, most episodes are resolved without long-term complications.

**Keywords:** pediatric anesthesia. laryngospasms. hypnotics and sedatives

## Introduction

The need for anesthetics in pediatrics goes beyond their use in the operating room. Moderate to intense sedation or even general anesthesia in children helps them to withstand diagnostic procedures or medical treatments (Hayes et al., 2020). In addition, the morbidity and mortality associated with pediatric anesthesia have fallen dramatically in the last 10 years (Tolosa et al., 2021). However, among the risks of sedoanalgesia in the pediatric age group, respiratory complications are the most feared, due to the high systemic demand for oxygen consumption and the low physiological reserve of the age group, easily predisposing to the occurrence of respiratory complications during induction of anesthesia (Liu et al., 2021).

Despite the advances made, post-anesthetic respiratory complications continue to be a concern due to their high frequency. In pediatrics, the incidence of significant complications is over 5.2%, and a considerable proportion of these cases could be avoided if there were adequate intervention by the professionals responsible (Tolosa et al., 2021). Studies show that more than half of patients undergoing an upper airway approach have at least one identifiable risk factor. It is therefore extremely important

that the preoperative assessment includes risk factors such as obstructive sleep apnea, respiratory tract infections in the last two weeks, partially controlled asthma or wheezing episodes three or more times in the last twelve months, wheezing and dyspnea on exercise, persistent nocturnal cough, a history of eczema, exposure to smoking, and a family history of asthma (von Ungern-Sternberg et al., 2019).

Tracheal intubation is a routine practice in pediatric anesthesia; however, despite advances in approaches and protocols, this procedure still represents one of the main causes of morbidity in children due to its physiological characteristics, which favor a rapid progression to hypoxia during apnea. Possible complications such as desaturation, laryngospasm, coughing, bronchospasm, and hypoxia, among others, can occur both during induction and during post-anesthetic recovery (Arican et al., 2021). These adverse events vary in severity, from minor problems such as desaturation (blood oxygenation of less than 95%) and upper airway obstruction (obstruction of the airway leading to snoring and respiratory discomfort) to more serious complications such as laryngospasm (complete obstruction of the airway associated with abdominal and thoracic muscle rigidity) and bronchospasm (increased respiratory effort, particularly during expiration, leading to wheezing on auscultation), which is even more prevalent in surgical procedures involving the airway (von Ungern-Sternberg et al., 2019).

Laryngospasm can occur at any stage of anesthetic preparation and usually manifests with the sign of inspiratory stridor that can progress to complete obstruction, increased respiratory effort, tracheal tugging, paradoxical respiratory effort, oxygen desaturation with or without bradycardia, and airway obstruction that does not respond to a supraglottic airway (Gavel and Walker, 2014). Laryngospasm occurs more commonly in pediatric anesthetic practices than in adults.

To optimize anesthetic management and reduce the risk of adverse events, various approaches are adopted, as discussed by Von Ungern-Sternberg et al. This includes the use of devices such as the laryngeal mask and different venous induction techniques with a variety of drugs. Among the agents used are propofol, opioids, benzodiazepines, ketamine, and dexmedetomidine, alone or in combination, each of which has its own risks and side effects and should be thoroughly analyzed by the anesthetic team before administration.

Therefore, it is important to identify early the risk factors that favor the onset of respiratory complications, in addition to considering the experience of the anesthesiologist, since the incidence of laryngospasm is higher among professionals with less experience (Lejus-Bourdeau et al., 2021). A systematic review is needed to assess the prevalence, risk factors, consequences, and management and prevention strategies for laryngospasm in children undergoing surgery. In addition, to evaluate the records of complications and clinical outcomes associated with physical and psychological impacts in pediatric patients, as well as to investigate early diagnostic techniques and signs that anticipate respiratory complications or therapeutic interventions for management, including considering both pharmacological and non-pharmacological approaches that may influence the outcome of the event.

It is necessary to investigate the precautionary measures that identify the sedatives and procedures that are most prone to laryngospasm and the risk factors for the development of this complication and the perioperative practices that are effective in preventing this event after the use of sedatives in children. These risks make it necessary to constantly evolve and re-evaluate anesthetic approaches in pediatrics in order to increase the percentage of successful procedures during the perioperative period (von Ungern-Sternberg et al., 2019). The main objective of this article is to discuss respiratory complications, with an emphasis on laryngospasm, during the use of anesthetics in pediatric procedures.

## Methods

In this systematic review, the following articles were considered eligible: (1) they were related to sedation and the occurrence of laryngospasm in pediatric surgeries; (2) they described pediatric surgeries and the risks associated with different types of sedatives; (3) they included the definition of laryngospasm in the pediatric context. It is limited to studies whose population is pediatric patients, with exposure to anesthetics with the outcome of laryngospasm.

Exclusion criteria included those that discussed the occurrence of laryngospasm in adults, as well as studies with samples not carried out on human beings, incomplete texts, duplicates, and texts not

in Portuguese, English, or Spanish.

A remote search was carried out on the available electronic platforms, using the Medical Literature Analysis and Retrieval System Online (MEDLINE, via PUBMED), Latin American and Caribbean Health Sciences Literature (LILACS), Scientific Electronic Library Online (SciELO), and Virtual Health Library (VHL) databases. The information for this study was obtained and collected by both researchers between May and August 2024, under the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA 2020) protocol.

A time limit was set, covering articles published between 2019 and 2024. The search strategy used covered articles written in Portuguese, English, and Spanish, with free availability of full text among clinical studies and randomized clinical trials. The articles were found using the Medical Subject Heading (MeSH) descriptors: "pediatric anesthesia", "laryngospasms" and "hypnotics and sedatives". The keywords used for the search process in English were: Pediatric Anesthesia OR Laryngospasms OR Hypnotics and Sedatives.

The selected quotes were studied and reviewed entirely by the two researchers independently in order to extract the necessary information about the importance of pediatric surgeries and the challenges associated with sedation and laryngospasm from the results and discussions.

The variables analyzed after selecting the articles identified by the researchers that answered the primary questions were: type of sedative used, laryngospasm during or after the surgical procedure, characteristics of the participants who developed laryngospasm, and their evolution afterwards.

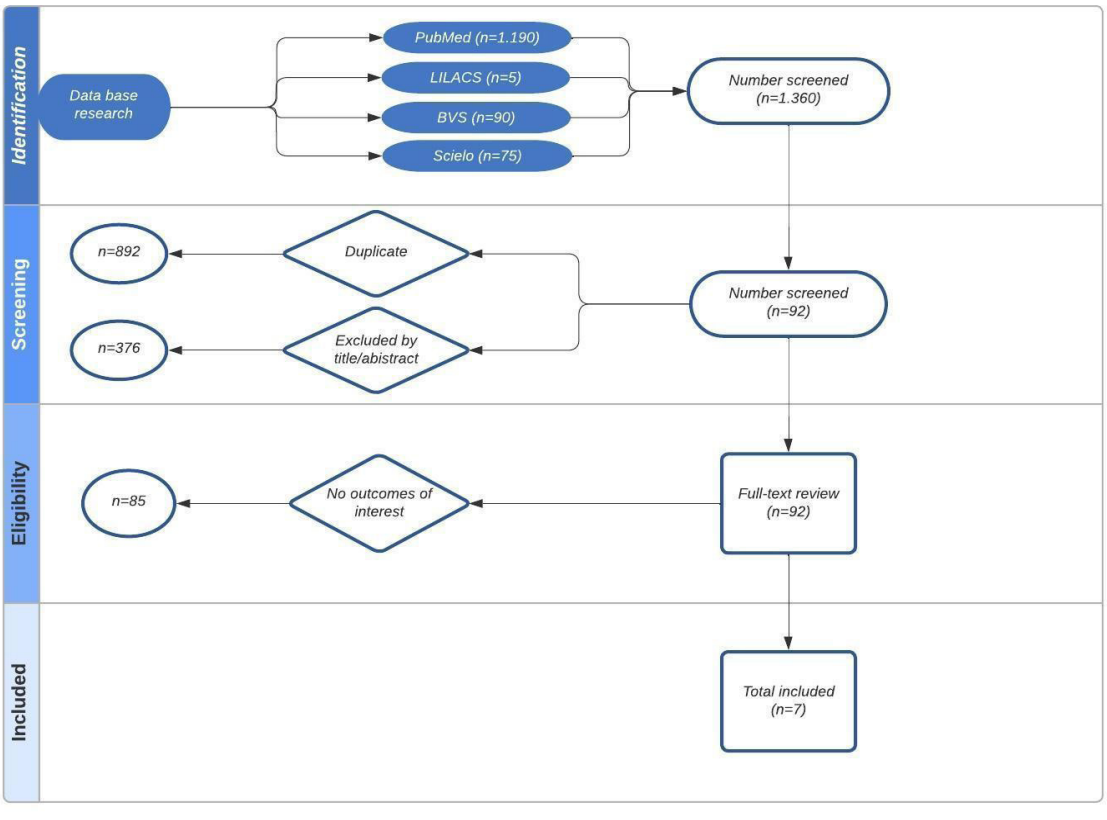
During the analysis of the included studies, it was assessed whether they had the necessary methodological quality and information to avoid selection, measurement, and confounding biases. The researchers compared the study groups in order to find similarities. The inclusion and exclusion criteria were carefully applied to make the review more homogeneous, generating applicability.

## Results

The initial search with the selected words in the databases totaled a selection of 1360 results, subsequently including the inclusion and exclusion criteria. At the end of the process, the titles and

abstracts of all the publications displayed in the search strategy were analyzed, and 7 studies agreed upon by both evaluators were selected. The study is detailed and described in the flowchart, according to PRISMA standards (Figure 1).

Figure 1. PRISMA flow diagram of study screening and selection.




Source: Authors.

The selected studies and their characteristics are detailed in Table 1, in order to visualize the type of study, objectives, results, and conclusion individually.

List of selected articles and their characteristics.

| Title | Design | Objective | Results | Conclusion |
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| Low-cost versus high-fidelity pediatric simulators for difficult airway management training: a randomized study in continuing medical education | Randomized trial | Compare the quality and educational impact of a full-scale simulation workshop with an infant simulator or with a low-cost simulator composed of an inert infant manikin with software that displays parameters on pediatric difficult airway management. | We enrolled 128 physicians. Direct participation SQS, observation SQS, ANTS scores, T0 SQS, T3 and T6 SQS were not different between groups. | Our low-cost simulator should be suggested as a less expensive alternative to an HF simulator for continuing medical education in pediatric difficult airway management. |
| The place of ultrasonography in confirming the position of the laryngeal mask airway in pediatric patients | Observational study | The incidence of suboptimal laryngeal mask airway position and replacement in children was evaluated using simultaneous ultrasound imaging. | The average age of the patients was 6.27 ± 4.66 years. After evaluation with ultrasonography, 79.3% of the laryngeal mask airways were found to be optimally positioned, while the position of 15.9% had to be corrected, and 4.9% had to be replaced. There was a moderate positive correlation between the ultrasonographic evaluation and leak test evaluation. | Relocation of the laryngeal mask airway was determined to be an independent risk factor affecting the development of complications. |
| Safety and Efficacy of the Combination of Propofol and Ketamine for Procedural Sedation/ Anesthesia in the Pediatric Population | Systematic Review and Meta-analysis | The purpose of this systematic review was to compare the safety and effectiveness of propofol and ketamine to other drug regimens. | Twenty-nine studies were included for analysis. Based on low-to-moderate quality evidence, we concluded that the use of propofol and ketamine may result in a slight-to-small reduction in the risk of hypotension, bradycardia, and apnea, and a slight increase in the risk of tachycardia, hypertension, and other respiratory adverse events, such as cough or laryngospasm. The ratio of propofol to ketamine and comparator drug regimen subgroups effects were important for desaturation and some secondary outcomes. | The use of propofol and ketamine had a minimal effect on the incidence of adverse events and other secondary outcomes. Large-scale studies are required to more accurately estimate adverse event rates and the effects of propofol and ketamine on patient-important outcomes. |
| Effect of Albuterol Premedication vs Placebo on the Occurrence of Respiratory Adverse Events in Children Undergoing Tonsillectomies | Randomized Clinical Trial | To determine whether inhaled albuterol sulfate (salbutamol) premedication decreases the risk of perioperative respiratory adverse events in children undergoing anesthesia for tonsillectomy. | Of 484 randomized children (median age, 5.6 [1.6-8.9] years; 58.9% boys, 479 data sets were available for intention-to-treat analysis. Perioperative respiratory adverse events occurred in 27.8% receiving albuterol and 47.9% receiving placebo. After adjusting for age, type of airway device, and severity of obstructive sleep apnea in a binary logistic regression model, the likelihood of perioperative respiratory adverse events remained significantly higher in the placebo group compared with the albuterol group. Significant differences were seen in children receiving placebo vs albuterol in laryngospasm. | Albuterol premedication administered before tonsillectomy under general anesthesia in young children resulted in a clinically significant reduction in rates of perioperative respiratory adverse events compared with the rates in children who received placebo. Premedication with albuterol should be considered for children undergoing tonsillectomy. |


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| Incidence of post-anesthetic respiratory complications in pediatrics. Observational, single-center study in Medellin, Colombia | Retrospective cohort study based on clinical record reviews | To describe the incidence of respiratory complications in the post-anesthesia care unit of an intermediate complexity center during a six-month period, and to explore the variables associated with major respiratory complications. | The records of 1181 patients were analyzed. The cumulative incidences of major complications were bronchospasm 1.44%, laryngospasm 0.68% and respiratory depression 0.59%. There were no cases of cardiac arrest or acute pulmonary edema. A history of respiratory infection less than 15 days before the procedure, rhinitis and female sex were associated with major respiratory complications. | A low frequency of respiratory complications was found during care provided by nursing staff trained in anesthesia recovery and pediatric airway in the post-anesthesia care unit. |
| Incidence of laryngospasm after extubation, with the "No Touch" in the pediatric population | A descriptive study | To assess the incidence of laryngospasm with the technique of "do not Touch" extubation, without oropharyngeal stimuli, in pediatric patients after general anesthesia. | 50% of the children presented cough reflex, after removing tracheal tube. Two children presented bronchospasm and two presented laryngospasm | The presence of laryngospasm with "do not Touch" extubation technique, was lower than that reported in the literature (5-21%). |
| Comparative Study of Haemodynamic Effects of Intravenous Ketamine-fentanyl and Propofol-fentanyl for Laryngeal Mask Airway Insertions in Children Undergoing Herniotomy under General Anaesthesia in a Nigerian Tertiary Hospital | Comparative study | We compared the haemodynamic effects of ketamine-fentanyl and propofol-fentanyl combinations for LMA insertion in pediatric patients who underwent herniotomy in our facility | The haemodynamic states of the patients were not statistically comparable as the heart rate, systolic, diastolic and mean arterial blood pressure were significantly higher and stable in the ketamine-fentanyl group than the propofol-fentanyl group. The incidence of apnea was significantly lower in the ketamine-fentanyl group compared with propofol-fentanyl group, but post-anaesthesia discharge scores were similar, with no significant difference in both groups. | The use of ketamine-fentanyl combination for LMA insertion in paediatric patients was associated with better haemodynamic changes and lower incidence of apnoea when compared with propofol-fentanyl combination. |

Source: Authors.


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Respiratory complications can be subdivided into severe primary outcomes: laryngospasm, bronchospasm, respiratory depression, cardiac arrest, and acute pulmonary edema; and minor or mild: stridor, persistent cough (lasting more than ten seconds), pharyngeal plug at the end of the procedure, airway bleeding, and residual muscle relaxation (Tolosa et al., 2021).

The overall incidence of laryngospasm was 0.87% in adults, 1.7% in pediatrics, and 2.82% in infants. The incidence of laryngospasm among pediatric patients undergoing surgery under general anesthesia was 57 (18.4%) in the study (Birlie and Yaregal, 2020). Of these, 34 (59.6%), 12 (21.1%), and 11 (19.3%) occurred during the emergency, maintenance, and induction phases of anesthesia, respectively. The incidence of laryngospasm in older children was double that of adults, while the incidence of laryngospasm in younger children was three times higher than that of adults (Olsson and Hallen, 1984).

Immediate clearing of airway secretions and adequate depth of anesthesia can help prevent laryngospasm. Inadequate depth of anesthesia, URTI, airway anomalies, multiple attempts at airway management, and oropharyngeal secretion were predictors of laryngospasm. Therefore, additional vigilance is required in patients with URTI, airway anomalies, or those who require multiple attempts at airway device insertion. Combining different drugs, rather than administering them alone, can reduce the dose required and minimize potential adverse effects (Hayes et al., 2020).

The comparative drug regimens in the control groups included various combinations of propofol, ketamine, and dexmedetomidine (Hayes et al., 2020). According to von Ungern-Sternberg et al., standard practice in his service does not include pre-oxygenation, opting for the combination of propofol with lidocaine to potentiate analgesia and inhalation induction with sevoflurane. Ketamine and fentanyl were combined with propofol to prevent depression of the cardiovascular system during insertion of the laryngeal mask; ketamine-fentanyl and propofol-fentanyl combinations have an analgesic effect. However, the cardiovascular effects of the two mixtures have not been fully evaluated in children (Okeyemi et al., 2022). In addition, strategies such as the use of β2-adrenergic agonists are employed to prevent an increase in respiratory resistance during intubation, especially beneficial for high-risk groups such as asthmatic children or those with recent respiratory tract infections (von Ungern-Sternberg et

al., 2019).

Albuterol, a β2-adrenergic agonist, has effects other than bronchodilation that may be beneficial during anesthesia. Of the risk factors previously identified for respiratory adverse events, many are associated with airway inflammation. Albuterol acutely, both in vivo and in vitro, inhibits the release of inflammatory mediators from mast cells and may therefore also contribute to the reduction of perioperative respiratory adverse events through reduced release of inflammatory markers and suppression of cough receptors and other reflexes (von Ungern-Sternberg et al., 2019).

The comparison between the use of propofol associated with ketamine or the use of ketamine alone in the pediatric population for sedation revealed a significant reduction in the risk of side effects such as nausea, vomiting, and hemodynamic and psychomimetic adverse events (Hayes et al., 2020). This study highlights the importance of minimizing complications during the sedation and recovery process. The recovery of airway reflexes after sedation is mediated by the activation of the sympathetic nervous system during the post-anesthetic awakening process, an essential physiological principle that underlies the decision to extubate only after the patient is fully awake (Tolosa et al., 2021).

Propofol is a short-acting agent that provides amnesia but no analgesia and can result in adverse events such as hypotension if administered in large doses. In contrast, ketamine, an N-methyl-d-aspartate (NMDA) acid receptor antagonist, induces a dissociated state with a low risk of airway compromise or apnea when administered slowly. Although ketamine does not significantly affect stable or elevated hemodynamic parameters (such as blood pressure and heart rate), it can cause psychomimetic disturbances (delirium) during the recovery phase. Both ketamine and dexmedetomidine maintain airway patency and respiratory drive better than propofol, potentially reducing the risk of desaturation (Hayes et al., 2020).

Lejus-Bourdeau et al. addresses a comparison between low-cost (LC) and high-fidelity (HF) pediatric simulators for training in difficult airway management, given that difficult intubation remains a significant cause of morbidity due to the physiological characteristics of infants and young children, contributing to the rapid onset of hypoxia during apnea. Through a randomized study with 128

physicians (including anesthesiologists, emergency physicians, and/or intensivists), participants were distributed into two groups  group, where they participated in training sessions with difficult intubation scenarios. The quality of the simulation, self-assessment of anesthesiologists' non-technical skills and educational quality, were assessed immediately after training and again after 3 and 6 months. Therefore, the low-cost simulator proved to be a viable and cost-effective alternative to the high-fidelity simulator for continuing education in the management of pediatric difficult airways, without compromising the participants perception of quality and educational impact.

Arican et al. records laryngospasm as one of the main in relation to complications during waking hours, it developed into laryngospasm in 6 patients (7.3%). A logistic regression analysis, including age, gender, ASA score, and relocation or correction after ultrasound, was performed to determine independent risk factors affecting the development of complications. laryngeal mask (LMA) relocation (OR = 2.961; p = 0.046; 95% Cl: 2.850---30.745) was determined to be an independent risk factor affecting the development of complications. The incidence of transient laryngospasm after LMA device placement was similar to that reported in other studies in which precautions were taken to ensure adequate depth of anesthesia prior to device placement. There is a significant positive relationship between airway management and the increased incidence of preoperative adverse events, such as laryngospasm and even death. Although LMA is not suitable for children undergoing surgery in all cases, it has shown clear benefits compared to endotracheal intubation. The frequency of preoperative adverse events in children using LMA for airway management is lower than when using other tools or endotracheal tubes.

Hayes et al. evaluated 29 randomized clinical studies with patients up to the age of 18 undergoing various procedures such as upper digestive endoscopy, cardiac catheterization, burn control, tooth extraction, hearing response testing, lumbar puncture, spinal aspiration, magnetic resonance imaging, interventional radiology, and fracture treatment. Among the adverse effects reported in his study was the description of the occurrence of laryngospasm, defined by other airway events, in 1676 patients. Fifteen studies contributed to the pooled analysis, which showed an increased risk of an event with

propofol and ketamine (RR 1.74, 95% CI, 1.07-2.83; P = 0.02), with a trivial difference in the absolute risk of 2 more events per 100 patients (95% CI, 0 to 6 more). The results of this systematic review and meta-analysis suggest that the combination of propofol and ketamine probably slightly increases the risk of respiratory events, such as cough and laryngospasm, in children and adolescents undergoing sedation. The propofol alone subgroup, which used higher total doses of propofol, had the lowest risk, which may be due to propofol's suppressive effects on airway smooth muscle reflexes. With the quality of evidence classified as low due to imprecision, it can be concluded that propofol and ketamine may slightly increase other types of airway and/or respiratory events.

Von Ungern-Sternberg et al. totaled his study with 479 children, (mean age 5.6); he cites the occurrence of one or more respiratory adverse events recorded in 67 children (27.8%) in the salbutamol group and 114 children (47.9%) in the placebo group. Laryngospasm, cough, and oxygen desaturation occurred significantly more often in the placebo group. Children in the placebo group were 2.4 times more likely to experience a respiratory adverse event compared to children who received salbutamol before an adenotonsillectomy or tonsillectomy (OR, 2.4; 95% CI, 1.6-3.5; P < 0.001). Statistically significant differences were present between the placebo and salbutamol groups in the prevalence of laryngospasm (28 [11.8%] vs. 12 [5.0%]; P = 0.009). This trial demonstrated a significant reduction in the incidence of perioperative respiratory adverse events in young children who received premedication with salbutamol before their procedure. For every 5 children undergoing adenotonsillectomy treated with salbutamol, one additional case of respiratory adverse events was prevented (NTT, 4.8; 95% CI, 8.6-3.5). Children receiving placebo had a 2.8 times greater chance of respiratory adverse events after adjusting for appropriate confounding factors, with laryngospasm being the most significantly reduced adverse events in children receiving salbutamol compared to placebo.

Tolosa et al. in his retrospective cohort study, collected from the post-anesthetic recovery unit, totaling 1181 patients under the age of 16, The median age was 4 years, 69.09% were male. The most frequently performed surgical procedures were specialized pediatric procedures (44.62%) and orthopedics (23.88%). The most frequently used device for airway management during surgery was the

endotracheal tube (ETT) with cuff (89.62%; n = 1027), 58.64%. Bronchospasm was the most frequent major complication (1.44%), followed by laryngospasm (0.68%). The incidence of bronchospasm was 15.8 per 1000 person-hours (95% CI [9.8-24.4]), while it was 7.4/1000 person-hours for laryngospasm (95% CI [3.7-14.8]). None of the studied factors was associated with the presence of laryngospasm. However, the literature suggests that this complication is associated with a superficial anesthetic plan associated with tachycardia, and its incidence may be reduced by the use of a LMA. The study has the differential of extubation in the anesthetic recovery room, and with the assistance of the nursing team, despite not being a commonly used method, the total frequency of serious respiratory complications was lower when compared to conventional care models. It also concludes that respiratory complications are more related to anesthesia than to the patient's history. In this cohort of pediatric patients, the care provided by nursing staff trained in anesthetic recovery resulted in a low frequency of respiratory complications in post-anesthetic recovery. The study also suggests that such a strategy could be implemented in other similar centers with the aim of optimizing operating room time and resources without compromising patient safety, but it is still important to insist on the need to identify avoidable factors that could result in respiratory complications.

Najar-Rodríguez et al. conducted a descriptive study on 100 children aged between 0 and 9 undergoing general anesthesia. The study reveals that the occurrence of laryngospasm is inversely related to the age of pediatric patients, with children under the age of 3 being three times more likely to face this complication. The diversity of surgeries included in the study, the age range of the participants, and the lack of comparison between extubation techniques contributed to the low incidence of laryngospasm observed. In addition to age, other relevant factors include the nature of the surgery and the anesthetic drugs used. Oral cavity surgical procedures such as tonsillectomy and adenoidectomy have a high incidence of laryngospasm, with a likelihood of complications between 21% and 27% higher compared to other surgeries. Similarly, bronchoscopy and endoscopy also increase the risk of laryngospasm. Among anesthetic agents, barbiturates are the most commonly associated with this complication. In the study, the "No Touch" extubation technique was adopted, in which the endotracheal tube is removed

only after the patient wakes up, followed by aspiration of oral secretions while still in the deep anesthetic plane, the patient is placed in a lateral position, and then oxygen is administered through the 100% mask. In this way, extubation only occurs when the lungs are inflated with moderate positive pressure, which reduces the abductor response of the laryngeal muscles and thus the occurrence of laryngospasm. Extubation was only performed when the patients had a respiratory rate appropriate for their age and the swallowing reflex was present. After removing the tube, two children (0.02%) had laryngospasm. The incidence of laryngospasm in the pediatric age group varies, with approximately 1.74% for children aged 0 to 9 years. This complication is more common and more severe in the first three months of life and increases to 2.8% in the school age group, especially among children with obesity and asthma.

Okeyemi et al. compares the hemodynamic effects of ketamine-fentanyl and propofol-fentanyl combinations for LMA insertion in children under anesthesia, whose complications include laryngospasm. This randomized comparative study was carried out on 80 children aged 1 to 15 years, physical status ASA I and II, who underwent herniotomy under general anesthesia. The incidence of apnea after insertion was significantly higher in patients who received propofol-fentanyl compared to patients who received ketamine-fentanyl, 33 (84.6%) patients versus 26 (65%) patients, P = 0.045. Predictably, the incidence of apnea in the propofol-fentanyl group should be higher than in the propofol-ketamine group because both fentanyl and propofol have the complication of apnea when used improperly during anesthesia. In addition, these drugs potentiate each other when combined, which can exert a synergistic apneic effect. We conclude that the use of the ketamine-fentanyl combination for insertion in pediatric patients was associated with better hemodynamic changes and a lower incidence of respiratory events.

## Conclusion

The discussions found emphasized the importance of subdividing respiratory complications into serious ones, with the occurrence of laryngospasm being emphasized in this study. The definition of laryngospasm is identifiable in all the articles analyzed as reflex closure of the vocal cords, which

can cause airway obstruction, a potentially serious complication in pediatric anesthesia, with a more common incidence in children than in adults, due to children's more sensitive anatomy and respiratory reflexes[13]. Risk factors include recent respiratory infections, asthma, exposure to tobacco and other airway irritants such as secretion or blood, gastroesophageal reflux, and superficial anesthesia and multiple attempts at airway management. Prevention is possible through the use of prophylactic measures such as the proper use of anesthetics, avoiding excessive airway manipulation, and careful monitoring during induction and recovery, depending only on the early identification and approach of signs of airway obstruction, such as stridor, absence of breath sounds and cyanosis[14]. Prevention includes the immediate clearing of secretions and the appropriate use of medications such as propofol, ketamine and albuterol. Studies show that combining medications can reduce adverse effects. Training simulators, both low and high cost, are effective in educating people about difficult airway management. Positive communication within anesthesia teams can improve clinical performance in critical situations. The prognosis, if properly managed, is that most episodes are resolved without long-term complications.

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