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Original Contribution

The risk factors of intraoperative anesthesia adverse events in children with laryngeal diseases ☆

Li-Qiao Yang MM (Attending doctor)[a,1], Jian-Wei Zhang MD (Attending doctor)[b,1], Jing-Jie Li MM (Associate Professor)[a,*], Cheng-Mi Zhang MM (Resident doctor)[a,*]

[a]*Department of Anesthesiology and Critical Care Medicine, Xinhua Hospital Affiliated to Shanghai Jiaotong University School of Medicine, Shanghai 20092, China*
[b]*Department of Anesthesiology, Shanghai Children's Medical Center Affiliated to Jiao Tong University School of Medicine, Shanghai 200127, China*

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Abstract

Background: This study aimed to investigate the risk factors of intraoperative anesthesia adverse events (IAAEs) in children with laryngeal diseases.

Methods: We retrospectively recruited 118 children with laryngeal diseases who underwent surgical therapy. Based on medical history and preoperative imaging diagnosis, the baseline data, including sex, age, weight, onset age, the number of operation, the degree of airway obstruction, the nature of disease, the location of disease, complications, tracheotomy, and trachea intubation, were defined and recorded. IAAEs, such as pulse oxygen saturation (SpO_2) decline, heart rate (HR) decline, emergency orotracheal intubation, emergency tracheotomy, and remaining intubated postoperatively, were also recorded. The risk factors for IAAEs were identified using multivariate logistic regression model.

Results: Increasing severity of airway obstruction and the presence of pneumonia were risk factors for SpO_2 and HR decline in children with laryngeal diseases. Older age, supraglottic rather than subglottic disease, and trachea intubation rather than unprotected airway during surgery were protective factors for SpO_2 decline. Furthermore, severe airway obstruction increased risks of emergency orotracheal intubation and remaining intubated postoperatively, whereas supraglottic rather than subglottic disease were protective factors for emergency orotracheal intubation and remaining intubated postoperatively. Only HR decline was found to be associated with the presence of congenital heart disease.

Conclusions: The severe airway obstruction increases the risk of SpO_2 decline and HR decline as well as the possibility of perioperative emergency orotracheal intubation and remaining intubated postoperatively, whereas supraglottic surgery and surgery performed under endotracheal intubation reduce the incidence rates of these IAAEs in children with laryngeal diseases.

☆ Conflict of interest: The authors have declared that no competing interests exist.

* Correspondence: Jing-Jie Li, MM, and Cheng-Mi Zhang, MM, Department of Anesthesiology and Critical Care Medicine, Xinhua Hospital Affiliated to Shanghai Jiaotong University School of Medicine, Kongjiang Road, Yanpu District, Shanghai 200092, China. Tel.:+86 21 60518573.

E-mail addresses: yangliqiao2323@hotmail.com (Y. Li-Qiao), Janewei0704@hotmail.com (Z. Jian-Wei), lijjjjddgd@hotmail.com (L. Jing-Jie), zhanggdgcf@sina.com (Z. Cheng-Mi).

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1. Background

Congenital laryngeal papilloma, laryngomalacia, laryngocele, and laryngeal hemangioma as well as airway stenosis caused by trauma and endotracheal intubation are common pediatric laryngeal diseases. Children with these laryngeal diseases are often accompanied by varying degrees of laryngeal obstruction [1]. Severe laryngeal obstruction can induce oxygen deficit, and not timely treatment can result in suffocation, thereby endangering the patient's life [2,3]. Currently, operative treatments, including radiofrequency ablation, laser treatments, and airway plasty, are main and effective methods for laryngeal diseases [4,5]. Because anesthesia is a conventional procedure during operative treatments, it is very important to establish an effective perioperative anesthesia managements.

In the past decades, the occurrence of critical incidents and perioperative mortality caused by poor anesthesia managements has a dramatic reduction because of new monitoring devices and pharmacological products [6,7]. Although the establishment of new guidelines for anesthesia managements has improved anesthetic practice [8], intraoperative anesthesia adverse events (IAAEs) still frequently occurred in children [9,10]. Furthermore, for children with laryngeal diseases, because of the same airway shared by surgery and anesthesia as well as the complicated airway managements, the incidence rate of IAAE may be increased. Therefore, it is essential to investigate the relative factors of IAAE in children with laryngeal diseases.

In the present study, we retrospectively recruited 118 children with laryngeal diseases and then identified the potential risk factors of IAAEs, aiming to provide a theoretical basis for anesthesia managements in children with laryngeal diseases.

2. Materials and methods

2.1. Patients

This retrospective study was approved by the Ethics Committee of Xinhua Hospital Affiliated to Shanghai Jiaotong University School of Medicine. Between January 2011 and December 2012, a total of 118 children (62 boys and 56 girls) aged 0 to 6 years who had laryngeal diseases and received surgical therapy in the department of otorhinolaryngology were included in this study. Among the 118 patients, there were 20 cases with laryngomalacia, 25 cases with laryngeal papilloma, 21 cases with laryngocele, 23 cases with laryngeal hemangioma, and 29 cases with airway stenosis. All children were diagnosed by computed tomography of the larynx combined with electronic bronchoscope and medical history.

2.2. Anesthetic method

When all children entered the operation room, heart rate (HR), respiration rate, noninvasive blood pressure, and pulse oxygen saturation (SpO_2) were monitored. Anesthesia was induced by inhalation of 8% sevoflurane with 100% oxygen at 8 L/min. After the loss of consciousness for 4 minutes, an aerosol solution of 1% tetracaine was sprayed over the laryngeal area. Surgery on the glottis supraglottic structures was performed with tracheal intubation, whereas surgery on the subglottic structures was performed under spontaneous breathing without tracheal intubation. For children who underwent operation with trachea intubation, once the eyelash reflex disappeared, trachea intubation was performed for artificial ventilation. For children with preoperative tracheotomy, tracheostomy tube was directly connected with anesthesia machine. For children who underwent operation without trachea intubation, 2% to 4% sevoflurane was continually inhaled to a sufficient depth of anesthesia. During operation, anesthesia was maintained with propofol (3-5 mg/kg per hour) and remifentanil (0.05-0.1 μg/kg per minute); then, dexmedetomidine (1 μg/kg) was infused in 15 minutes. In addition, dexamethasone (0.2 mg/kg) was injected to prevent and reduce the occurrence of postoperative laryngeal edema. Remaining intubated postoperatively was decided according to intraoperative and postoperative conditions. For children with supraglottic surgery, remaining intubated postoperatively was advised if postoperative laryngeal edema and insufficient oxygen supply appeared. For children with subglottic surgery, tracheal intubation was performed at the end of the surgery in children who had postoperative laryngeal edema and insufficient oxygen supply.

2.3. Monitoring index

Based on medical history and preoperative imaging diagnosis, the baseline data including sex (man and woman), age (<3 months, 3-12 months, and >12 months), weight (<5 kg, 5-10 kg, 10-20 kg, and >20 kg), onset age (<3 months, 3-12 months, and >12 months), the number of operation (1 and >1), the degree of airway obstruction (grade 1, grade 2, grade 3, and grade 4), the nature of disease (laryngomalacia, laryngeal papilloma, laryngocele, laryngeal hemangioma, and airway stenosis), the location of disease (supraglottis, glottis, and subglottis), complications (pneumonia and congenital heart disease [CHD]), tracheotomy (yes and no), and trachea intubation (yes and no) were defined and recorded. IAAEs, such as SpO_2 decline (SpO_2, <90%), HR decline (HR decline, ≥30% baseline value), emergency orotracheal intubation, emergency tracheotomy, and remaining intubated postoperatively, were also recorded. The degree of airway obstruction was defined as follows: grade 1, dyspnea and inspiratory stridor only appeared after activities; grade 2, dyspnea and inspiratory stridor appeared at rest and enhanced after activities, while sleeping and eating were not affected; grade 3, patients had obvious dyspnea, inspiratory stridor, symptoms of cyanosis in lips and fingers, concave upward sternum, and clavicle as well as affected sleeping and eating and fidgets; and grade 4, patients had severe dyspnea, cyanosis, disorientation, coma, and low blood pressure [1].