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Clinical Observation of Double Tube Laryngeal Mask in Fast-Track Anesthesia for Limb Orthopedic Surgery in Children with Cerebral Palsy

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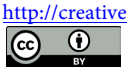

Abstract

Objective: To compare and analyze the effect and safety of double tube laryngeal mask and endotracheal intubation general anesthesia in fast track anesthesia for limb orthopaedic surgery in children with cerebral palsy. **Methods:** 78 children with cerebral palsy undergoing limb orthopedic surgery were randomly divided into laryngeal mask group and intubation group, with 39 cases in each group. The perioperative hemodynamic indexes, anesthesia effect related indexes, anesthesia related complications or adverse reaction rates of the two groups were observed and compared between the two groups. **Results**: When the two groups of children entered the room, there was no significant difference in MAP and HR ($P > 0.05$); MAP and HR of children in the intubation group were higher than those in the laryngeal mask anesthesia group ($P < 0.05$); The BIS values of patients in laryngeal mask group were significantly higher than those in intubation group ($P < 0.05$); the incidence of anesthesia related complications in intubation group was higher than that in laryngeal mask group ($P < 0.05$). **Conclusion:** Laryngeal mask is used to establish the airway of intravenous general anesthesia in limb orthopaedic surgery of children with cerebral palsy, which is conducive to the stability of children's circulatory and respiratory system, to reduce the impact of narcotic drugs on children, to reduce the incidence of postoperative anesthesia related complications, and to improve the anesthetic effect. It meets the requirements of fast track anesthesia, and can be widely used in clinical practice.

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Keywords

Laryngeal Mask Anesthesia, Tracheal Intubation Anesthesia, Limb Orthopedic Surgery in Children with Cerebral Palsy, Anesthetic Effect

1. Introduction

Limb orthopaedic surgery in children with cerebral palsy mainly adjusts muscle tension through a series of tendon relaxation, extension, transposition or contraction, combined with selective posterior rhizotomy and practical rehabilitation treatment, so as to alleviate the limb spasm, improve limb motor function and improve quality of life. It is the most effective method to relieve cerebral palsy spasm and improve limb function [1]. It has the characteristics of simple operation, less trauma, short operation time and low muscle relaxation requirements. However, due to the young age, physical development and poor resistance of children with cerebral palsy, the requirements are stricter than those of normal children when receiving anesthesia and surgical treatment. Moreover, it is often necessary to implement multiple operations in a centralized manner, which requires a safe and efficient anesthesia method and drug combination with rapid recovery and less adverse reactions to improve the operation turnover rate. Laryngeal mask is loved by many anesthesiologists because of its convenient use, maintaining airway patency, avoiding organ mucosal damage and being able to tolerate under shallow anesthesia [2]. Relevant studies [3] believe that the design of double tube laryngeal mask (esophageal drainage type) is more in line with the physiological and anatomical characteristics of children's airway. After implantation, it has little irritation to the airway and can effectively prevent accidental inhalation. The purpose of this paper is to observe the application of laryngeal mask ventilation anesthesia in fast track anesthesia for short orthopaedic surgery in children with cerebral palsy, and to explore the clinical safety and feasibility of this method.

2. Data and Methods

2.1. General Information

78 children with cerebral palsy who underwent limb orthopedic surgery in our hospital from October 2021 to January 2022 were selected. The children were randomly divided into laryngeal mask group and intubation group, with 39 cases in each group. There were 27 males and 12 females in the laryngeal mask group, aged 6 - 12 years, with an average of (8.25 ± 1.35) years, and a body weight of 15 - 27 kg, with an average of (21.12 ± 2.14) kg. There were 26 males and 13 females in the endotracheal intubation group, aged from 5 to 12 years, with an average of (8.12 ± 1.25) years, and a body weight of 13 to 26 kg, with an average of (21.15 ± 2.08) kg. Inclusion criteria: 1) The age of children is less than or equal to 12 years old; 2) All of them were in accordance with the surgical indications of

children with cerebral palsy, And no other diseases; 3) The guardians of the children had informed consent. There was no significant difference in general data between the two groups ($P > 0.05$).

2.2. Method

Children were routinely fasted and forbidden to drink. After entering the room, they were injected with atropine 0.01 mg/kg and dexamethasone 0.3 mg/kg intravenously, and connected with a multifunctional monitor to continuously monitor the vital signs of children. Laryngeal mask group: anesthesia induction was performed by intravenous injection of fentanyl: 10 ug/kg, propofol: 3 mg/kg, remifentanil: 1 ug/kg, rocuronium: 0.3 - 0.5 mg/kg according to the weight of the children. The laryngeal mask model suitable for the model and specification was selected according to the weight of the children (No. 1.5 for children with a weight of 5 - 10 kg, No. 2 for children with a weight of 10 - 20 kg, and No. 2.5 for children with a weight of 20 - 30 kg). The laryngeal mask was placed and fixed properly according to the specifications, At the same time, adjust the posture of the children to determine that the airway pressure is below 20 mmhg, observe whether the laryngeal mask leaks, and then place the drainage tube through the laryngeal mask. Determine the position of the head end of the drainage tube through the air injection test, and the drainage tube is not subjected to continuous negative pressure suction. Anesthesia maintenance: Remifentanil 0.2 - 0.5 ug/(kg·min) and propofol 6 - 12 mg/(kg·h) were pumped intravenously to maintain anesthesia, and the dosage of propofol was adjusted according to the depth of anesthesia and various vital signs of children [4]. Intubation group: the anesthesia induction and anesthesia maintenance schemes are the same as those in laryngeal mask group. Endotracheal tube is selected for intubation according to the individual situation of children. Propofol was stopped 10 minutes before the end of the operation, and remifentanil was reduced to 0.05 UG/kg·h for continuous infusion until the tracheal tube (laryngeal mask) was removed. When the tidal volume of the child reaches more than 7 ml/kg and SpO_2 rises to more than 98%, send it to the recovery room for monitoring and recovery. When the swallowing reflex recovers, remove the laryngeal mask or endotracheal tube.

2.3. Observation Indicators

During anesthesia, keep the airway pressure below 20 cm H_2O and the end expiratory carbon dioxide partial pressure between 35 - 45 mmHg. Collect and sort out the hemodynamic indexes (When entering the room, intubation (laryngeal mask), 5 min after intubation (laryngeal mask), extubation (laryngeal mask)) and bispectral index (BIS) value, anesthesia recovery related indexes and anesthetic drug dosage (wake-up time, extubation time, dosage of propofol and remifentanil), anesthesia related complications or adverse reaction rate of the two groups during the perioperative period of anesthesia (entering the room, intubation (laryngeal mask), 5 minutes after intubation (laryngeal mask), extubation (laryngeal mask), and comparison between the two groups.

3. Statistical Methods

The measurement data are expressed in ($\bar{X}$ ± s) and t-test is used; the counting data is expressed in (n, %), using χ^2 test, with $P < 0.05$, the difference is statistically significant.

4. Results

4.1. Perioperative Hemodynamic Indexes

When the two groups of children entered the room, there was no significant difference in Mean arterial pressure(MAP) and heart rate(HR) ($P > 0.05$); Intubation (laryngeal mask), 5 min after intubation (laryngeal mask), extubation (laryngeal mask), MAP and HR in intubation group were higher than those in laryngeal mask anesthesia group ($P < 0.05$); At 5 minutes after intubation (Laryngeal mask) and extubation (Laryngeal mask), the BIS values of children in Laryngeal mask anesthesia group were higher than those in intubation group ($P < 0.05$). The experimental results were shown in Table 1.

4.2. Relevant Indexes of Anesthesia Recovery and Dosage of Narcotic Drugs

The relevant indexes of anesthesia recovery and the dosage of anesthetic drugs, the awake time, extubation time, and the dosage of propofol and remifentanil in the laryngeal mask group were lower than those in the intubation group. The experimental results were shown in Table 2.

4.3. Occurrence of Adverse Reactions

The total incidence of choking and adverse reactions in intubation group was significantly higher than that in laryngeal mask group ($P < 0.05$). The experimental results were shown in Table 3.

Table 1. Changes of perioperative hemodynamic indexes and BIS values in the two groups [($\bar{X}$ ± s), n = 39].

time	group	MAP (mmHg)	HR (bpm)	BIS
When entering the room	Intubation group	82.1 ± 11.2	121.0 ± 10.3	96.3 ± 8.2
	Laryngeal mask group	82.3 ± 10.1	122.6 ± 11.1	95.4 ± 8.3
When intubation (laryngeal mask)	Intubation group	88.9 ± 12.1*	139.7 ± 13.1*	48.7 ± 6.1
	Laryngeal mask group	82.9 ± 15.1	127.6 ± 10.6	49.3 ± 8.2
5 min after intubation (laryngeal mask)	Intubation group	89.9 ± 11.9*	142.0 ± 12.7*	48.5 ± 7.3*
	Laryngeal mask group	83.1 ± 10.4	112.7 ± 12.4	54.2 ± 7.2
When extubating (laryngeal mask)	Intubation group	104.0 ± 9.6*	129.3 ± 12.9*	68.6 ± 6.3*
	Laryngeal mask group	87.9 ± 10.8	95.3 ± 10.5	75.8 ± 9.2

Note: compared with LMA group, *$P < 0.05$.

Table 2. Comparison of anesthesia recovery related indexes and dosage between the two groups [($\bar{X}$ ± s), n = 39].

group	Operation time (min)	Time from drug withdrawal to wakefulness (min)	Time from drug withdrawal to extubation (laryngeal mask) (min)	Propofol (mg)	Remifentanil (ug)
Intubation group	65.7 ± 17.8	15.2 ± 3.1*	20.2 ± 3.1*	357.2 ± 15.8*	535.6 ± 8.7*
Laryngeal mask group	65.8 ± 22.0	9.4 ± 1.3	15.6 ± 2.5	208.4 ± 11.8	465.4 ± 7.3

Note: *compared with LMA group, P < 0.05.

Table 3. Comparison of adverse reactions between the two groups [n (%), n = 39].

group	Convalescent agitation	Respiratory depression	Laryngeal spasm	respiratory tract infection	Reflux aspiration	Choking cough	Postoperative sore throat	Total incidence
Intubation group	5 (12.8)	3 (7.69)	1 (2.56)	1 (2.56)	0 (0.00)	10* (2.56)	4 (10.26)	24* (61.53)
Laryngeal mask group	1 (2.56)	1 (2.56)	0 (0.00)	0 (0.00)	0 (0.00)	2 (5.13)	1 (2.56)	5 (12.82)

Note: *compared with LMA group, P < 0.05. Respiratory depression: refers to oxygen inhalation by mask of 3 L/min, SpO_2 < 95%.

5. Discussion

Cerebral palsy is a group of spastic paralysis caused by brain diseases. It refers to the non progressive brain injury syndrome that occurs in the neonatal period. Relevant studies [5] believe that the incidence of perioperative complications in patients with cerebral palsy is 63% and the mortality is 0.1%. The vast majority are children. Due to the lack of cognitive ability and poor compliance with anesthesia surgery, it is usually necessary to choose general anesthesia for surgery. However, the sequelae of children with cerebral palsy are mostly abnormal muscle tone and low tension of upper respiratory tract, which often leads to the impairment of the ability to clear pharyngeal secretions; Respiratory weakness and paralysis often lead to different degrees of restrictive ventilation disorder [6]. In addition, children's tongue body is large, epiglottis is long, and functional residual capacity is small. For poor CO_2 accumulation and processing capacity, respiratory tract management during anesthesia is particularly important for children [7]. Therefore, general anesthesia without intubation is not conducive to the respiratory tract management of patients with cerebral palsy, and may lead to insufficient ventilation, even respiratory obstruction and aspiration. General anesthesia with endotracheal intubation can effectively control the respiratory tract of children, but it is an invasive operation. The intubation operation is very irritating to the respiratory tract of children, which may lead to abrasions, edema or ulcers in the throat [8]. Deep anesthesia may cause delayed awakening. Choking, breath holding and agitation in children during extubation will also increase the incidence of laryngeal spasm [9]. Laryngeal mask is a common airway management tool between mask and endotracheal tube. The laryngeal mask does not need to pass through the subglottic and deep structure. It is simple and convenient to be placed, with small hemodynamic changes and less adverse res-

piratory reactions. After inflation, it forms a low-pressure sealing ring in the throat and has a good fit with the throat, which can effectively ensure the unobstructed respiratory tract of patients [10], and has the same ventilation effect as endotracheal tube. For short and small operations with simple operation, it is an ideal airway management tool for fast channel anesthesia under the condition of strict preoperative fasting and water.

In this observation study, laryngeal mask ventilation was applied to intravenous general anesthesia in children with cerebral palsy, and compared with endotracheal intubation. It was found that there was no significant difference in basic map, HR and BIS between the two groups ($P > 0.05$); the map and HR of patients in LMA group during intubation (LMA), 5 minutes after intubation (LMA) and extubation (LMA) were significantly lower than those in endotracheal intubation group ($P < 0.05$), The stimulation to the throat is usually mild [11], so the stress response is mild. The BIS value of laryngeal mask group was significantly higher than that of intubation group ($P < 0.05$); the time from drug withdrawal to wakefulness and from drug withdrawal to extubation in LMA group were shorter than those in endotracheal intubation group. The difference was statistically significant ($P < 0.05$). The incidence of postoperative adverse reactions in laryngeal mask group was significantly lower than that in intubation group ($P < 0.05$); there was no significant difference in operation time between the two groups ($P > 0.05$). The reason may be that laryngeal mask removal under intravenous general anesthesia can reduce the activity of upper respiratory tract reaction, and sedation and analgesia can meet the psychological and physiological intervention of pediatric anesthesia. Gao Yu [12] and others searched the databases of Cochrane, PubMed, web of science, EMBASE, Wanfang and China HowNet by computer. The retrieval time was from the establishment of the database to July 2019. Finally, 35 clinical randomized controlled trials (RCTs) comparing the application of laryngeal mask and endotracheal intubation in airway management of pediatric general anesthesia were included. The study found that laryngeal mask used by pediatric general anesthesia patients (age ≤ 14 years, gender unlimited, ASA grade I or II) has good cardiovascular stability, it can also effectively reduce laryngospasm, bronchospasm, sore throat, postoperative hoarseness and other postoperative complications.

In addition, when using laryngeal mask clinically, ventilation leakage and reflux aspiration are the most common concerns of anesthesiologists. Especially under continuous positive pressure ventilation, the peak airway pressure exceeding 20 cm H_2O is very prone to gastrointestinal flatulence. Therefore, sufficient preoperative preparations must be made, such as strict fasting water, necessary gastrointestinal decompression and so on. In this study, the laryngeal mask group used esophageal drainage laryngeal mask for positive pressure ventilation, and no obvious signs of reflux such as choking and hypoxemia were found. However, due to the limitation of monitoring conditions, the possibility of undetected small amount of reflux cannot be ruled out. In addition, although all children in the LMA group successfully completed the operation under general anesthesia

with LMA, there are still a considerable number of patients who cannot be implanted with LMA at one time or have air leakage. Although the placement or adjustment is finally completed under video laryngoscope, repeated attempts will inevitably lead to pharyngeal and laryngeal injury or even edema. Therefore, appropriate laryngeal mask type, appropriate oropharyngeal sealing pressure and airway peak pressure are also important indicators to ensure the safety and effectiveness of laryngeal mask ventilation [13].

In conclusion, laryngeal mask ventilation general anesthesia shows great advantages in stabilizing the hemodynamic indexes of children, shortening the relevant indexes of anesthesia recovery, reducing the dosage of anesthesia maintenance drugs and reducing the rate of anesthesia related complications. It shows that laryngeal mask general anesthesia is more suitable for children with cerebral palsy than endotracheal intubation general anesthesia. Laryngeal mask is used for the establishment of airway of intravenous general anesthesia in limb orthopedic surgery of children with cerebral palsy, which is conducive to the stability of children's circulatory and respiratory system, reduces the impact of narcotic drugs on children, reduces the incidence of postoperative anesthesia related complications, improve the quality and comfort of children in the recovery period, and meet the requirements of fast channel anesthesia. It can be safely and effectively used in clinical anesthesia.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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