

Effect of Right Supine Tracheal Extubation on Respiratory Complications and Airway Pressure in the Waking Period of General Anesthesia in Pediatric Stomatology

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Abstract

Objective: The purpose of this study was to investigate the effect of right supine endotracheal intubation on respiratory complications and airway pressure of general anesthesia, and to provide guidance for clinical application.

Methods: Seventy-two children who received oral treatment under general anesthesia from November 2020 to November 2021 in Yantai Stomatological Hospital were randomly divided into three groups, 24 cases in each group. All three groups of children entered the PACU after the surgery. The children in Group I were extubated in the supine position, the children in Group II were immediately changed to the right decubitus after extubation in the horizontal position, and the children in Group III were extubated in the right decubitus. HR, MAP and SpO₂ of T1 (the time point at the beginning of surgery), T2 (the time point at 1 hour after surgery), T3 (the time point after extubation), T4 (the time point at 1 minute after extubation), T5 (the time point at 3 minutes after extubation) in the three groups were observed, t1 (operation time) and t2 (the time of leaving the PACU) were recorded. The airway pressure (P1) in the recumbent position and the airway pressure (P2) in the right decubitus position before extubation were recorded in Group III. The number of sputum suction and complications after extubation were counted. **Results:** The t2 in Group III was shorter than that in Groups I and II, and the number of sputum suction in Group III was less than that in Groups I and II ($P < 0.05$). The HR at T3, T4 and T5 in Group III was lower than that in Group I, and the HR at T4 and T5 was lower than that in Group II ($P < 0.05$). There were significant differences in the incidence of respiratory complications among the

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three groups ($P < 0.05$). The incidence of asphyxia, bucking and glossocoma postoperative agitation in Group III was significantly lower than that in Group I, and the incidence of asphyxia and choking was lower than that in Group II ($P < 0.05$). The incidence of glossoptosis in Group II was significantly lower than that in Group I ($P < 0.05$). In Group III, the airway pressure P2 in the right decubitus position during endotracheal intubation was higher than that of P1 in the supine position during endotracheal intubation ($P < 0.05$). The 95% Confidence Interval (CI) of airway pressure difference was 1.416 - 1.834 cmH₂O. **Conclusion:** For children undergoing intraoral therapy under general anesthesia, tracheal extubation in the right decubitus position can improve the circulation fluctuation before and after extubation, reducing the number of sputum suction and respiratory tract-related complications, and can shorten the departure time. The body position change during the tracheal intubation will slightly increase the airway pressure, but the supine position after extubation can better ensure the smooth spontaneous breathing of children, which can provide the reference for clinical application.

Keywords

Lateral Decubitus Position, Intraoral Therapy for Children, General Anesthesia, Respiratory Complications, Airway Pressure

1. Introduction

In China, deciduous teeth of children aged 3 - 5 have a high incidence of caries [1]. Children with dental phobia can reach 80% [2]. Many children can not cooperate with oral doctors for oral treatment; forced bondage can cause adverse psychological effects on children. Dental general anesthesia for children is that anesthesiologists use intravenous or inhaled anesthetics to make children unconscious. Close monitoring by anesthesiologists during operation can ensure the safety of children, and stomatologists can safely carry out intraoral therapy [3]. Studies at home and abroad have shown that compared with protective fixation, the treatment of pediatric dental diseases under general anesthesia has the advantages of high safety, rapid bed turnover, significant improvement in the oral environment and quality of life after surgery [4] [5] [6]. But children's intraoral therapy often needs intraoral irrigation, and they have more oral secretions than adults. Besides, under the action of anesthetic drugs, the child loses some or all of the sensory function, the protective reflex is weakened or disappeared; the respiratory and digestive system function is suppressed to varying degrees. Postoperative extubation is easy to cause accidental inhalation of secretions into the trachea, which causes respiratory tract-related complications such as hypoxemia, laryngeal spasm, bronchospasm and even asphyxia death, which can also induce agitation in the awakening period and affect the quality of awakening [7]. In addition, if the tracheal cuff is insufficient pressure will also cause postoperative extubation of as-

piration [8]. Studies have shown that the extubation of children at different body positions can affect the quality of the awakening period [9] [10]. This study aims to explore the impact of right decubitus extubation on respiratory complications and airway pressure during the awakening period of children's general anesthesia.

2. Materials and Methods

2.1. Patients

This study has been approved by the Ethics Committee of Yantai Stomatological Hospital (Approval number 2021007). Seventy-two children who received intra-oral therapy under general anesthesia in Yantai Stomatological Hospital from November 2020 to October 2021 were selected. All children had no organic diseases such as heart disease, lung, liver and kidney, and had no history of respiratory tract infection, asthma and bronchitis in the past two weeks. According to the random number table method, 72 cases of children were randomly divided into three groups: Group I (supine position group), Group II (supine position to right decubitus position group), Group III (right decubitus position group), 24 cases in each group, Group I. The general data of Group I children are as follows, 13 male and 11 female children, with average age of (3.83 ± 1.05) years, mean height of (106.58 ± 8.79) cm, and mean weight of (18.40 ± 3.25) kg. The general data of Group II children are as follows, 11 male and 13 female children, with average age of (3.67 ± 0.82) years, mean height of (104.42 ± 7.56) cm, and mean weight of (16.83 ± 2.88) kg. The general data of Group III children are as follows, 10 male and 14 female children, with average age of (3.67 ± 0.82) years, mean height of (104.54 ± 8.17) cm, and mean weight of (18.08 ± 3.61) kg. There was no significant difference in general data among the three groups ($P > 0.05$).

2.2. Methods

All children had no significant preoperative abnormalities. The child's family members signed an informed consent form for anesthesia. Anesthesia-induced drugs and maintenance drugs were the same in the three groups of children. All patients underwent nasal intubation. After surgery, all children were admitted to PACU for resuscitation. After the Steward Score reaches 6 points, Group I children were extubated in supine extubation. In Group II, the children were immediately changed to the right decubitus after extubation in the supine position. In Group III, children changed from supine position to right decubitus after the operation and extubated in the rightdecubitus. In Group III, the endotracheal tube was protected by the anesthesiologist in the right decubitus position to prevent displacement, and placed the thin pillow under the head and kept the head in the middle position. In order to prevent serious respiratory adverse events in the children, all three groups of children underwent mask oxygen inhalation (set with oxygen flow of 5 L/min), which were observed, recorded, and treated by the same anesthesiologist after intubation.

2.3. Observational Indicators

HR (Heart rate), MAP (Mean arterial pressure) and SPO₂ (Blood oxygen saturation) of T1 (the time of the beginning of surgery), T2 (the time of 1 hour after the start of the surgery), T3 (the time point after tracheal extubation), T4 (the time point at 1 minute after extubation), T5 (the time point at 3 minutes after extubation) in the three groups were observed., t1 (operation time) and t2 (the time of leaving the PACU) were recorded. The airway pressure (P1) in the recumbent position and the airway pressure (P2) in the right decubitus position before extubation were recorded in Group III. The number of sputum suction and complications after extubation were counted, such as postoperative hypoxemia (SpO₂ < 90%), asphyxia, choking, glossocoma, laryngospasm, bronchospasm, etc.

2.4. Observational Indicators

All statistical analyses were conducted with SPSS17.0, Quantitative data are expressed as mean \pm SD, that used A t-test or ANOVA, Paired Samples T Test was used to compare airway pressure P1 and P2 in Group III. χ^2 test or Fisher's exact test were used for counting data. The counting data that did not obey the normal distribution were expressed by rank mean and kruskal-Wallis test was used, Comparisons between groups were performed using the Bonferroni method, P values < 0.05 were considered statistically significant.

3. Results

3.1. The Comparison of t1, t2 and Sputum Aspiration Times among the Three Groups

There was no significant difference in the operation time among the three groups ($P > 0.05$). The time of leaving PACU in Group III was shorter than that in Group I and Group II and the number of sputum aspiration in Group III was less than that in Group I and Group II. The time of leaving PACU in Group III was shorter than that in Group II, and the number of sputum aspiration in Group III was less than that in Group II, the difference was statistically significant ($P < 0.05$). The results were shown in **Table 1**.

Table 1. The comparison of t1, t2 and sputum aspiration times among the three groups.

| Group | t1 (min) | t2 (min) | The number of sputum aspiration |
|--------------------|--------------------|-------------------------------|---------------------------------|
| Group I (n = 24) | 132.71 \pm 24.54 | 8.83 \pm 1.99 | 46.94 |
| Group II (n = 24) | 135.83 \pm 18.98 | 7.54 \pm 1.87 | 37.75 |
| Group III (n = 24) | 128.17 \pm 25.92 | 6.04 \pm 1.37 ^{ab} | 24.81 ^{ab} |
| F/ χ^2 values | 0.655 | 15.087 | 17.739 |
| P values | 0.523 | 0.000 | 0.000 |

Note: Compared with Group I, P^a < 0.05; compared with Group II, P^b < 0.05.

3.2. Comparison between HR, MAP, and SPO₂ at Each Time Point in the Three Group of Children

The HR of Group III at T3, T4 and T5 was lower than that of Group I, and the HR at T4 and T5 was lower than that of Group II, with statistically significant differences ($P < 0.05$). The MAP of Group III at T3 was lower than that of Group I, and the SpO₂ at T4 and T5 was higher than that of Group II. The difference was statistically significant, $P < 0.05$. The results were shown in **Table 2**.

3.3. Comparison of Resuscitation Complications among Three Groups

Kruskal-wallis test was performed on the incidence of complications in the three groups, $\chi^2 = 8.295$, $P = 0.011 < 0.05$, with the rank mean of 15.29 in Group I $>$ 11.79 in Group II $>$ 5.93 in Group III. The occurrence of waking respiratory complications was significantly different between the three pediatric groups. The occurrence of bucking, asphyxia, choking, glossocoma and postoperative agitation was significantly lower than that in Group I, and asphyxia and choking were lower than that in Group II, with significant differences ($P < 0.05$). The occurrence of glossocoma was significantly lower than that in Group I, and the difference was statistically significant ($P < 0.05$). The results were shown in **Table 3**.

3.4. Comparison between P1 and P2 after Tracheal Intubation in the Group of Children

In Group III of children, the airway pressure P2 after the right decubitus of tracheal intubation was higher than the P1 in the supine position, which was statistically significant ($P < 0.05$), with 95% C I 1.416 to 1.834, the results were shown in **Table 4**.

4. Discussion

In recent years, with the widespread recognition of the concept of comfort medicine, the intraoral therapy for children under general anesthesia has been widely

Table 2. Comparison between HR, MAP, and SPO₂ at each time point in the three groups of children.

| Item | Group | T1 | T2 | T3 | T4 | T5 |
|-------------------------|-----------|----------------|---------------|----------------------------|------------------------------|----------------------------|
| HR (times/min) | Group I | 100.29 ± 12.58 | 94.00 ± 9.10 | 107.33 ± 11.74 | 125.58 ± 16.97 | 115.50 ± 16.22 |
| | Group II | 102.42 ± 15.50 | 97.13 ± 11.27 | 105.25 ± 10.44 | 120.29 ± 14.36 | 112.71 ± 16.05 |
| | Group III | 100.42 ± 11.53 | 93.46 ± 11.96 | 97.42 ± 14.46 ^a | 108.29 ± 13.72 ^{ab} | 99.13 ± 9.90 ^{ab} |
| MAP (mmHg) | Group I | 68.54 ± 10.67 | 58.42 ± 6.69 | 62.46 ± 6.12 | 62.83 ± 5.51 | 63.04 ± 5.74 |
| | Group II | 64.12 ± 10.11 | 57.54 ± 6.34 | 59.29 ± 7.53 | 61.42 ± 7.65 | 63.17 ± 7.11 |
| | Group III | 64.25 ± 12.66 | 56.33 ± 7.25 | 56.79 ± 9.03 ^a | 58.75 ± 9.13 | 61.25 ± 7.01 |
| SpO ₂ (%) | Group I | 99.96 ± 0.20 | 99.88 ± 0.34 | 99.75 ± 0.53 | 93.67 ± 3.46 | 95.46 ± 2.13 |
| | Group II | 99.92 ± 0.28 | 99.96 ± 0.20 | 99.96 ± 0.20 | 95.21 ± 2.65 | 96.79 ± 3.89 |
| | Group III | 99.96 ± 0.20 | 99.94 ± 0.23 | 99.75 ± 1.03 | 97.58 ± 1.64 ^{ab} | 97.63 ± 1.06 ^a |

Note: Compared with Group I, P^a < 0.05; compared with Group II, P^b < 0.05.

Table 3. Comparison of resuscitation complications among three groups.

| Group | asphyxia | bucking | Glossocoma | Postoperative agitation | Laryngismus | Bronchospasm | Hyochemia |
|-----------|-----------------|-----------------|----------------|-------------------------|-------------|--------------|-----------|
| Group I | 10 | 18 | 16 | 10 | 2 | 1 | 5 |
| Group II | 8 | 14 | 2 ^c | 8 | 0 | 1 | 3 |
| Group III | 1 ^{ab} | 6 ^{ab} | 0 ^a | 3 ^a | 0 | 0 | 0 |

Note: Compared with Group I, P^a < 0.05; compared with Group II, P^b < 0.05; compared with Group I, P^c < 0.05.

Table 4. Comparison between P1 and P2 after tracheal intubation in the group of children.

| Items | P1 (cmH ₂ O) | P2 (cmH ₂ O) | 95%CI (cmH ₂ O) |
|-----------------|-------------------------|-------------------------|----------------------------|
| $\bar{x} \pm s$ | 18.000 ± 1.474 | 19.625 ± 1.408 | |
| t values | | -16.098 | 1.416 - 1.834 |
| P values | | 0.000 | |

carried out due to its various advantages. Due to the physiological and anatomical reasons of children, such as short neck and tongue body hypertrophy, children are easy to cause glossocoma after general anesthesia [11]. The oral secretion and blood during intraoral therapy are easy to remain in the mouth of children, and also easy to cause aspiration after general anesthesia extubation [12]. Therefore, the focus of ensuring the safety of children's intraoral therapy of general anesthesia is how to effectively reduce respiratory complications after extubation. Some scholars [13] had found that: in pediatric patients, deep extubation in the lateral position improved SpO₂ and reduced the incidence of stridor and laryngospasm in the early emergence period when compared to extubation in the supine position. The results of this study show that: in Group III, SpO₂ at 1 min and 3 min after extubation in right decubitus position was higher than that in Group I, and the circulation fluctuation was more stable than that in Group I. And compared with Group II, in the supine tracheal intubation immediately changed to the right decubitus position, the improvement of SpO₂ and stable circulation still existed. In addition, the number of sputum aspirations in Group III was also significantly less than that in Group I and Group II, which might be related to the easy drainage of oral secretions and flushing water in the lateral decubitus position.

The respiratory complications are one of the main causes of perioperative morbidity in children, with a focus on prevention [14]. This study found that fewer respiratory complications in Group I and Group II, the incidence of asphyxia, choking, glossocoma and postoperative agitation decreased significantly, and the time to leave the PACU was significantly shortened, reflecting the advantages of inferior tracheal extubation in the right decubitus position to improve the quality of awakening and airway protection. Although the incidence of glossocoma was lower, the incidence of other respiratory complications did not be significantly reduced, indicating that Group II in the supine tracheal intuba-

tion would still have the possibility of airway aspiration. Asphyxia, bucking and postoperative agitation caused by aspiration would still affect the awakening quality and the time to leave the PACU of children, this study also confirms this point. In addition, the present study monitored the airway pressure after tracheal intubation in the supine and right decubitus positions of Group III, and found that the airway pressure in the right decubitus position was higher than in the supine position, with a 95% CI of 1.416 to 1.834 (cmH₂O), The reason is to consider the pressure on the neck tissue on both sides of the airway, appropriate pressure can clamp tracheal duct sleeve, airway closure is better, to prevent oral secretions into the trachea, and the secretions from the upper part of the tracheal catheter sleeve can also be taken away after tracheal intubation to prevent the glossocoma and facilitate the maintenance of autonomous respiration. Studies [15] have found that lateral positioning decreases upper airway obstruction in anesthetized adults and individuals with sleep apnea during sleep. Increasing upper airway cross-sectional area and total upper airway volume when compared with the supine position in sedated, spontaneously breathing children. Therefore, compared with tracheal extubation in the supine position, spontaneous respiration can be better maintained after tracheal extubation in the lateral position.

Limitations of This Study

1) The sample size is still small, and there is a lack of comparative research of large samples; 2) Due to the differences in the airway length, intubation depth and tooth damage degree of the children, whether the impact on the research results needs to be further studied; 3) Whether the preoperative crying and whether the intraoperative oral operation stimulation can affect the research results also needs to be investigated.

To sum up, children with general anesthesia after the right lateral position tracheal extubation, can reduce the circulation fluctuation and the number of sputum suction after extubation. Besides, this way can also lower respiratory complications, and can shorten the time to leave the PACU. Although the airway pressure will increase after the lateral supine position, it can more maintain the patency of independent breathing and is worth clinical promotion and application.

Conflicts of Interest

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

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