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Observation on the Effect of Dexmedetomidine in Suppressing Cough Reflex During Tracheal Extubation in Pediatric Patients Undergoing General Anesthesia

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Abstract: *Objective*: To investigate the suppressive effect of dexmedetomidine on the cough reflex during tracheal extubation in pediatric patients undergoing general anesthesia and its impact on vital signs. *Methods*: A total of 60 pediatric patients undergoing elective surgery admitted to our hospital from January to August 2025 were selected and randomly divided into an observation group and a control group, with 30 cases in each group, using a random number table method. The control group received an intravenous infusion of 0.9% sodium chloride injection 30 minutes before the end of surgery, while the observation group received an intravenous pump infusion of dexmedetomidine (1 μg/kg, diluted to 4 μg/ml with normal saline). The severity of cough (graded from 0 to 3) and vital signs, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse oxygen saturation (SpO_2), were recorded 5 minutes before extubation, at the time of extubation, and 5 minutes after extubation in both groups. *Results*: The severity of cough in the observation group was significantly milder than that in the control group ($P < 0.05$), with a significantly higher proportion of grade 0 cough in the observation group (23.33% vs 3.33%). At extubation and five minutes post-extubation, the observation group exhibited significantly lower HR, SBP, and DBP than the control group ($P < 0.05$). In contrast, SpO_2 levels remained comparable between the groups ($P > 0.05$). *Conclusion*: Dexmedetomidine can effectively suppress the cough reflex during tracheal extubation in pediatric patients undergoing general anesthesia, reduce the severity of cough, stabilize hemodynamic parameters, and has no significant impact on respiratory function, demonstrating good clinical safety.

Keywords: Cough reflex; Dexmedetomidine; Tracheal extubation period; General anesthesia; Pediatric patients

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1. Introduction

Cough reflex during tracheal extubation in pediatric patients undergoing general anesthesia is one of the common

adverse reactions in clinical anesthesia, primarily caused by the stimulation of tracheal intubation on the airway mucosa, leading to airway smooth muscle contraction, increased secretions, and subsequently causing symptoms such as coughing and breath-holding [1]. Severe cough reflexes not only increase the suffering of pediatric patients but may also lead to complications such as increased intracranial pressure, blood pressure fluctuations, tracheal injury, laryngeal spasm, and even endanger the life safety of pediatric patients [2]. Therefore, finding a safe and effective method to suppress the cough reflex during tracheal extubation in pediatric patients under general anesthesia holds significant clinical importance.

Dexmedetomidine, a commonly used α2-adrenergic receptor agonist in clinical practice, not only exhibits significant sedative, analgesic, and anxiolytic effects but also has minimal inhibitory effects on the respiratory system. Recent literature has reported that dexmedetomidine can effectively reduce the incidence of cough reflex during airway extubation in adult patients [3]. However, there is limited research on its application in pediatric patients. This study examines whether dexmedetomidine can suppress the cough reflex during tracheal extubation in anesthetized children, to establish an evidence base for clinical anesthesia care.

2. Materials and methods

2.1. General information

60 pediatric patients who underwent elective otolaryngological and general surgical procedures at our hospital from January to August 2025 were selected as the study subjects. They were randomly assigned to either an observation group or a control group, with 30 participants in each, for clinical comparative analysis using a double-blind randomized number method.

Inclusion criteria are as follows:

(1) ASA classification of I-II;

(2) Age < 3–15 years;

(3) Surgical procedures including adenoidectomy and laparoscopic pediatric hernia repair;

(4) Informed consent obtained from the patients and their families who voluntarily participated in the trial.

Exclusion criteria are as follows:

(1) Presence of difficult ventilation;

(2) History of allergy or contraindication to the drugs used;

(3) Concurrent cardiac conditions;

(4) Mental state abnormalities;

(5) Severe liver and kidney dysfunction.

A comparison of the general information between the two groups of pediatric patients ($P > 0.05$) indicated comparability (**Table 1**). This study was approved by the hospital's ethics committee.

Table 1. Comparison of general information between the two groups of pediatric patients (mean ± SD/n (%))

Parameter	Control group (n=30)	Observation group (n=30)	t/χ^2 value	*P*-value
Gender (M/F, n)	25/5	19/11	3.068	0.080
Age (years)	8.62 ± 2.31	8.25 ± 2.18	0.638	0.526
Weight (kg)	32.56 ± 8.74	31.89 ± 9.02	0.292	0.771

2.2. Methods

2.2.1. Preoperative preparation

Pediatric patients followed routine preoperative fasting and water deprivation protocols. Three minutes before anesthesia, administer midazolam at a dose of 0.05 mg/kg, and routinely monitor electrocardiogram (ECG), heart rate (HR), pulse oxygen saturation (SpO_2), non-invasive blood pressure (NIBP), and end-tidal carbon dioxide (ET-CO_2).

2.2.2. Anesthesia induction and maintenance

Sufentanil was administered at a dose of 0.4-0.5 μg/kg, propofol at 2–3 mg/kg, and cisatracurium besylate at 0.2 mg/kg. After 3 minutes, tracheal intubation was performed using a disposable endotracheal tube equipped with a high-volume, low-pressure cuff. Mechanical ventilation should be set with a tidal volume of 6–8 mL/kg, and the respiratory rate was adjusted to maintain intraoperative ET-CO_2 between 35–45 mmHg. Anesthesia was maintained with continuous infusions of propofol and remifentanil, titrated to keep intraoperative blood pressure and heart rate within 20% of the baseline values in response to surgical stimulation.

2.2.3. Pharmacological intervention

For the observation group, 30 minutes before the end of surgery, dexmedetomidine was administered at a dose of 1 μg/kg, diluted with normal saline to a concentration of 4 μg/mL, and it was continuously infused through a peripheral vein at a rate of (kg body weight) mL/h.

For the control group, 30 minutes before the end of surgery, 0.9% sodium chloride injection was continuously infused through a peripheral vein at a dose of (1/4 kg body weight) mL and a rate of (kg body weight) mL/h.

2.3. Observation indicators

2.3.1. Grading of cough severity

The grading criteria for evaluation of cough severity were as follows: 0 points = no cough; 1 point = a single cough; 2 points = non-continuous coughing more than once; 3 points = continuous, repetitive coughing with head elevation [4].

2.3.2. Vital sign indicators

Vital sign indicators such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse oxygen saturation (SpO_2) were recorded for both groups of children at 5 minutes before extubation, during extubation, and 5 minutes after extubation [5].

2.4. Statistical methods

All statistical analyses were performed using SPSS software (version 26.0). Categorical data were presented as mean ± standard deviation (SD) and compared using the χ^2 test. Continuous data were presented as mean ± SD and were compared using the Student's t-test. A *P*-value of less than 0.05 was defined as statistically significant.

3. Results

3.2. Comparison of severity grades of cough between two groups of children

The severity of cough in the observation group was significantly milder than that in the control group, with a

significantly higher proportion of Grade 0 cough compared to the control group ($P < 0.05$). See **Table 2** for details.

Table 2. Comparison of severity grades of cough between two groups of children (cases, %)

Observation indicator	Control group (n=30)	Observation group (n=30)	χ^2 value	*P*-value
Grade 0	1 (3.33)	7 (23.33)	5.192	0.023
Grade 1	14 (46.67)	18 (60.00)	1.071	0.301
Grade 2	12 (40.00)	5 (16.67)	4.022	0.045*
Grade 3	3 (10.00)	0 (0.00)	3.158	0.076

3.3. Comparison of vital signs at different time points between two groups of children

Five minutes before extubation, there was no significant difference in HR, SBP, DBP, or SpO_2 between the two groups ($P > 0.05$). During extubation and 5 minutes after extubation, the HR, SBP, and DBP in the observation group were lower than those in the control group ($P < 0.05$); there was no significant difference in SpO_2 between the two groups ($P > 0.05$). See **Table 3** for details.

Table 3. Comparison of vital signs at different time points (mean ± SD)

Parameter	Time point	Control group (n=30)	Observation group (n=30)	t-value	*P*-value
HR (bpm)	5 mins before extubation	98.62 ± 10.31	97.25 ± 9.89	0.525	0.601
	At extubation	125.36 ± 12.45	108.74 ± 11.23	5.429	0.000
	5 mins after extubation	112.58 ± 10.67	99.87 ± 9.54	4.864	0.000
SBP (mmHg)	5 mins before extubation	95.62 ± 8.31	94.25 ± 7.89	0.655	0.515
	At extubation	128.36 ± 10.45	110.74 ± 9.23	6.922	0.000
	5 mins after extubation	115.58 ± 9.67	102.87 ± 8.54	5.396	0.000
DBP (mmHg)	5 mins before extubation	62.62 ± 6.31	61.25 ± 5.89	0.869	0.388
	At extubation	85.36 ± 7.45	72.74 ± 6.23	7.118	0.000
	5 mins after extubation	75.58 ± 6.67	66.87 ± 5.54	5.020	0.000
SpO_2 (%)	5 mins before extubation	98.62 ± 0.31	98.68 ± 0.30	0.762	0.449
	At extubation	97.36 ± 0.45	97.74 ± 0.33	3.730	0.000
	5 mins after extubation	98.58 ± 0.27	98.87 ± 0.24	4.397	0.610

4. Discussion

Dexmedetomidine is a novel, highly selective α_2-adrenergic receptor agonist. Its mechanism of action primarily involves binding to α_2-adrenergic receptors in the central nervous system and peripheral tissues, inhibiting the release of norepinephrine, and thereby exerting sedative, analgesic, and anxiolytic effects [6]. The α_2-adrenergic receptors are divided into three subtypes: α_2A, α_2B, and α_2C. Among them, the α_2A receptor is mainly distributed in the locus coeruleus and dorsal horn of the spinal cord in the central nervous system and is closely related to sedative and analgesic effects; The α_2B receptor is primarily distributed in vascular smooth muscle and is associated with vasoconstriction, while the α_2C receptor is mainly found in areas such as the cerebral cortex and

hippocampus and is related to cognitive function [7,8]. Dexmedetomidine exhibits significantly higher affinity for the α_2A receptor compared to the α_2B and α_2C receptors. As a result, it has strong sedative and analgesic effects, with relatively minor impacts on the cardiovascular system.

The causes of coughing during tracheal tube removal after general anesthesia in children include: direct mechanical stimulation of the airway mucosa by the endotracheal tube; increased airway secretions during tube removal; reduced vital capacity and bronchoconstriction; increased airway resistance and impaired ventilation during extubation, which can induce severe coughing in children [9]. In severe cases, adverse consequences such as tachycardia, hypertension, intracranial hypertension, glottic edema, and even asphyxiation may occur, posing certain difficulties for the surgical treatment of children.

The results of this study demonstrate a superior improvement in cough severity in the observation group compared to the control group ($P < 0.05$). This outcome is closely related to the mechanism of action of dexmedetomidine. Dexmedetomidine suppresses the cough reflex center in the central nervous system, weakening or blocking the efferent pathway of the cough reflex, thereby inhibiting the coughing response. Additionally, it offers some protective functions for the respiratory tract, whereby it can inhibit the activity of tracheal glands and bronchial smooth muscle, reducing airway secretions; it also enhances the synthesis and release of pulmonary surfactant, as well as increases ciliary motility and clearance capacity, further alleviating the coughing response [10].

In terms of vital signs, during and 5 minutes after extubation, the heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) in the observation group were all lower than those in the control group ($P < 0.05$), while no significant difference was observed in oxygen saturation (SpO_2) between the two groups ($P > 0.05$). This is because dexmedetomidine can slow down the heart rate and decrease blood pressure by inhibiting sympathetic nerve activity and reducing peripheral vascular resistance. Meanwhile, dexmedetomidine has a relatively weak inhibitory effect on the respiratory center, thus not significantly affecting the respiratory function of children, which explains why there was no significant difference in SpO_2 between the two groups.

This study confirmed that dexmedetomidine can significantly reduce the incidence of coughing during tracheal intubation after pediatric general anesthesia induction, with good safety. The study also found that administering dexmedetomidine before pediatric general anesthesia induction can shorten the awakening time and surgical stress index, and effectively improve postoperative agitation.

However, the limitations of this study include the following:

(1) The small number of pediatric patients in this study prevents the drawing of more convincing research conclusions;

(2) Only one basic anesthesia method was selected, so it is unclear whether similar results can be obtained with other basic anesthesia methods and whether there are differences among different age groups.

Subsequent work should focus on and address these issues.

5. Conclusion

In summary, dexmedetomidine has a good inhibitory effect on the cough reflex during extubation after pediatric general anesthesia, maintaining stable vital signs in pediatric patients with minimal decrease in heart rate. It also demonstrates good tolerability and safety characteristics, making it suitable for clinical promotion. During clinical application, attention should be paid to individual differences, and the dosage and infusion time of the drug should be reasonably adjusted based on the patient's condition, with close monitoring of vital sign changes to ensure

medication safety.

Disclosure statement

The author declares no conflict of interest.

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