

Original Research Article

Combined remifentanil/sevoflurane in paediatric tonsil surgery anesthesia: Effect on recovery time of respiration and consciousness in paediatric patients

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Sent for review: 21 January 2023

Revised accepted: 29 April 2023

Abstract

Purpose: To evaluate the effectiveness of combined remifentanil/sevoflurane anesthesia on hemodynamic stability and postoperative recovery in paediatric tonsil surgery.

Methods: In this prospective study, a total of 102 paediatric patients who underwent tonsil surgery in Taihe County People's Hospital between February 2021 and April 2022 were recruited and randomized at a ratio of 1:1 to receive either propofol alone (control group) or remifentanil plus sevoflurane (study group) during paediatric tonsil surgery, with 51 patients in each group. The anaesthetic effect of the two regimens was the primary endpoint and was evaluated by monitoring the mean arterial pressure (MAP), heart rate (HR) and oxygen saturation (SpO₂) levels of the patients before anaesthesia (T0), immediately after intubation (T1), at the beginning of surgery (T2) and at extubation (T3).

Results: Remifentanil plus sevoflurane resulted in more stable MAP and HR of patients at T1, T2 and T3 than propofol alone ($p < 0.05$). Furthermore, patients in the two groups exhibited similar SpO₂ levels at T0, T1, T2 and T3 ($p > 0.05$).

Conclusion: The combined use of remifentanil and sevoflurane anaesthetics is effective in paediatric patients undergoing tonsil surgery and thus may offer a viable alternative for such clinical practice. The drug combination maintains intraoperative haemodynamic stability in patients, boosts postoperative recovery, and lowers the risk of postoperative adverse events.

Keywords: Remifentanil, Sevoflurane, Paediatric, Tonsil surgery, Anaesthesia, Respiratory recovery time, Consciousness recovery time

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INTRODUCTION

Paediatric tonsillar lesions are associated with recurrent high fever and sore throat, which result in a detrimental impact on the growth of children [1], and recent data have shown a rising

prevalence of paediatric tonsillar lesions in China [2]. Minor tonsillar lesions are typically managed by anti-infective drugs, while the worsening of tonsillar lesions often necessitates surgical interventions to improve patient prognosis [3], such as tonsillectomy. However, tonsillectomy

may compromise the respiratory function of the patient. Therefore, the postoperative recovery of spontaneous breathing and consciousness of patients serve as critical indicators of patient conditions [4]. Furthermore, anaesthesia for children demands more clinical attention compared to that of adults [5].

Sevoflurane is a recently developed inhalational anaesthetic drug that offers several benefits to the paediatric population, including low blood gas distribution coefficient and low irritation, resulting in a more rapid onset of action and better postoperative recovery [6]. Remifentanyl, on the other hand, is a commonly used intravenous continuous anaesthetic with rapid onset of action and rapid metabolism [7]. Previous literature [8] has reported the excellent efficacy of combining sevoflurane with remifentanyl in paediatric tonsillectomy.

The present study was performed to investigate the anesthetic effect of combined remifentanyl/sevoflurane in paediatric tonsil surgery.

PATIENTS AND METHODS

General information

A total of 102 paediatric patients who underwent paediatric tonsil surgery in Taihe County People's Hospital between February 2021 and April 2022 were recruited and randomised into a control group and a study group, with 51 patients in each group.

Ethical approval

The study was approved by the ethics committee of Taihe County People's (approval no. 2022-10). All procedures were conducted in accordance with the protocol of Helsinki Declaration [8].

Inclusion and exclusion criteria

Inclusion criteria

Children who were aged ≤ 12 years and underwent paediatric tonsil surgery in Taihe County People's Hospital, with ASA classification of grades I-II, and whose families were informed of the study and signed the informed consent were included.

Exclusion criteria

Children with contraindications to paediatric tonsil surgery or the used anaesthetics, serious organ diseases, co-morbid psychiatric disorders

or related family history, or severe immunological disorders, and whose families rescinded their consent were excluded.

Administration of anaesthesia

The patients in both groups were nil by mouth before surgery and received atropine (Shanxi Tianyuan Pharmaceutical Co. Ltd, Nation Drug Administration no. H14021324) at a dose of 0.01 mg/kg through intramuscular injection 30 min before surgery. Intravenous access was established, oxygen was administered by mask, and the patient's intraoperative vital signs such as ECG, mean arterial pressure (MAP), heart rate (HR) and blood oxygen saturation (SpO₂) were monitored.

Control group

The patients in the control group received propofol (Hebei Yipin Pharmaceutical Co., Ltd., Nation Drug Administration NO. H20093542) at a dose of 2 - 3 mg/kg and cisatracurium besilate (Jiangsu Hengrui Pharmaceutical Co., Ltd., Nation Drug Administration NO. H20183042) at a dose of 0.1 mg/kg via intravenous injection. This was followed by induction of anaesthesia with remifentanyl (Jiangsu Enhua Pharmaceutical Co., Ltd., Nation Drug Administration NO. H20143314) at a dose of 1 μ g/kg, and tracheal intubation was performed. Intraoperatively, remifentanyl at a dose of 0.25 μ g/kg/min and propofol at a dose of 100 μ g/kg/min were administered for intraoperative anaesthetic maintenance.

Study group

The patients in the study group were given sevoflurane mixed with oxygen via mask inhalation, with the sevoflurane concentration being gradually increased from 1 to 3 % and at an oxygen flow rate of 4 L/min. After loss of consciousness, the patient was given remifentanyl at a dose of 1 μ g/kg and cisatracurium besilate at a dose of 0.1 mg/kg via slow intravenous drip. The patient was then intubated with conventional mechanical ventilation set at a frequency of 12 breath/min, a tidal volume of 8 mL/kg and a partial pressure of 35 - 49 mmHg of end-expiratory carbon dioxide. Intraoperative inhalation of sevoflurane at 3 % and pumping of remifentanyl at a dose of 0.25 μ g/kg/min were continued. The concentration and pump speed were adjusted according to the depth of anaesthesia of the patient. At the end of the operation, sevoflurane inhalation and remifentanyl pumping were discontinued.

Evaluation of parameters/indices

Anaesthetic effect

Anaesthetic effect was evaluated based on the haemodynamic indexes of the patient at different surgical time points. The haemodynamic indexes evaluated included arterial pressure (MAP), heart rate (HR) and oxygen saturation (SpO₂) levels before anaesthesia (T0), immediately after intubation (T1), at the beginning of surgery (T2) and at extubation (T3) in the two groups. The more stable the haemodynamic parameters at each time point, the better the anaesthetic outcome.

Post-operative related recovery indicators

The postoperative recovery indicators, including time-elapsing before postoperative recovery of spontaneous breathing, consciousness, and extubation, were recorded.

Adverse reactions

Adverse reactions in the patients due to anaesthetic drugs were nausea and vomiting, respiratory depression, restlessness and cardiac arrhythmias.

Satisfaction with treatment

A satisfaction questionnaire was developed by the hospital and given to the patient's family for satisfaction scoring. There were 20 questions on this form, and the child's family members scored each question out of 5 points, with a total score of <70 points indicating dissatisfied, 70-89 points indicating satisfied, and ≥90 points indicating highly satisfied.

Statistical analysis

All the data obtained in this study were collated and analysed using SPSS 22.0. Measurement data are expressed as mean ± standard

deviation (SD) and compared using t-test, while count data are expressed as number/proportion of cases (%) and tested using χ^2 . $P < 0.05$ indicates that the difference is statistically significant. GraphPad Prism 8 was used as the software for plotting the images.

RESULTS

General information

The two groups were well-balanced in terms of baseline patient profiles ($p > 0.05$), as shown in Table 1.

Haemodynamic index levels at different time points

Remifentanyl plus sevoflurane resulted in more stable MAP and HR levels of patients at T1, T2 and T3 than propofol alone ($p < 0.05$). Furthermore, patients in the two groups exhibited similar oxygen saturation (SpO₂) levels at T0, T1, T2 and T3 ($p > 0.05$). (Figure 1)

Levels of selected recovery indicators after surgery

As shown in Figure 2, the time-elapsing before postoperative recovery of spontaneous breathing, consciousness, and extubation were 6.84 ± 2.39 , 8.92 ± 3.47 , and 9.54 ± 3.18 for the control group and were 3.64 ± 1.72 , 5.43 ± 2.51 , and 6.81 ± 2.83 for the study group. Patients administered with remifentanyl plus sevoflurane experienced significantly shorter time-elapsing before postoperative recovery of spontaneous breathing, consciousness, and extubation than those with propofol ($p < 0.05$).

Adverse reactions

The incidence of postoperative adverse reactions in the control group was 17.6 % (9 / 51),

Table 1: Comparison of general information {mean ± SD, n (%)}

Variable	Control group (n=51)	Study group (n=51)	t/ χ^2	P-value
Gender			0.168	0.682
Male	33	31		
Female	18	20		
Age (years)	3-11	3-11		
Mean age (years)	6.45±2.17	6.10±2.24	-0.777	0.441
Weight (kg)	14-65	16-65		
Mean weight (kg)	28.85±12.19	26.49±10.31	-1.009	0.318
Duration of disease (months)	1-6	1-7		
Mean duration (months)	3.07±0.53	3.19±0.55	-1.122	0.265
ASA grading			0.206	0.65
Grade I	39	37		
Grade II	12	14		

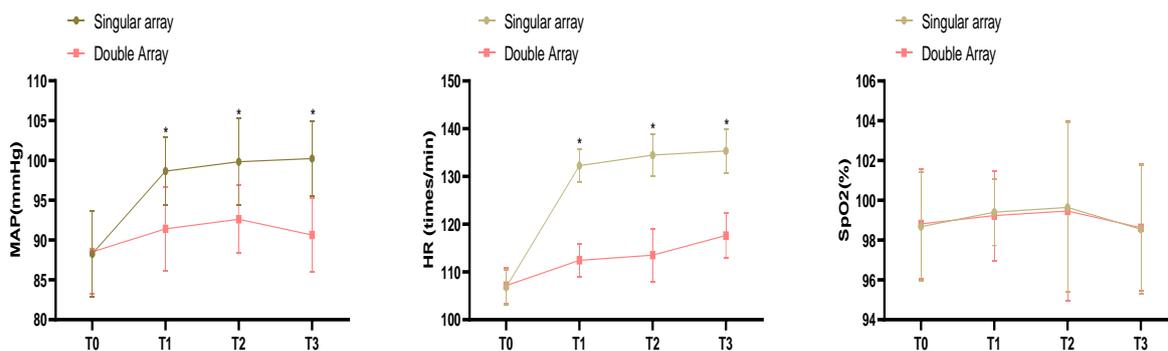


Figure 1: Level of haemodynamic indices at different time points (mean ± SD). *P* < 0.05

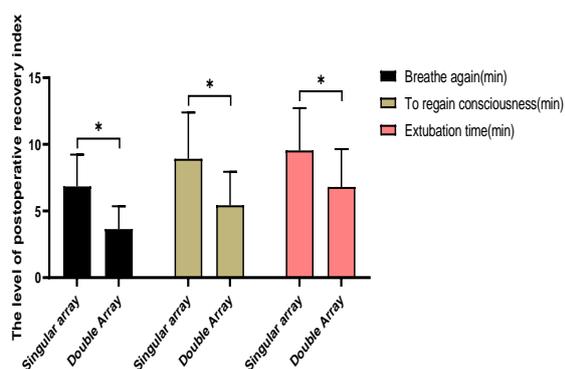


Figure 2: Comparison of postoperative levels of relevant recovery indicators (mean ± SD) in the two groups. **P* < 0.05

and it comprised 3 cases of nausea and vomiting, 1 case of respiratory depression, 4 cases of agitation and 1 case of arrhythmia. The incidence of postoperative adverse reactions in the study group was 3.9 % (2/51). This comprised 1 case of nausea and vomiting and 1 case of agitation (*p* < 0.05), as shown in Table 2.

Treatment satisfaction

The total treatment satisfaction in the control group was 82.4 % (42 / 51), comprising of 9 cases of dissatisfied, 27 cases of satisfied, and 15 cases of highly satisfied. The total treatment satisfaction of the study group was 98.0 % (50 / 51), comprising of 1 case of dissatisfied, 29 cases of satisfied and 21 cases of highly

satisfied. The patients were more satisfied with the dual-drug anaesthesia regimen combining remifentanyl with sevoflurane than single propofol (*p* < 0.05), as shown in Table 3.

DISCUSSION

Paediatric tonsillar lesions are associated with a high morbidity rate and usually require surgical interventions for improved prognosis [9]. Local anaesthesia has been used for tonsil surgery previously, but the outcome of local anaesthesia is compromised when applied in paediatric patients due to their young age and poor compliance [10].

Table 2: Comparison of adverse reactions {n (%)}

Adverse reaction	Control group (n=51)	Study group (n=51)	χ^2	<i>P</i> -value
Nausea and vomiting	3	1	-	-
Respiratory depression	1	0	-	-
Restlessness	4	1	-	-
Cardiac arrhythmias	1	0	-	-
Total incidence (%)	17.6% (9/51)	3.9% (2/51)	4.993	0.025

Table 3: Comparison of treatment satisfaction [n (%)] between the two groups

Group	Number of examples	Poor satisfied	Satisfied	Highly satisfied	Overall satisfaction rate
Control	51	9	27	15	82.4%(42/51)
Study	51	1	29	21	98.0%(50/51)
χ^2	-	-	-	-	7.096
P-value	-	-	-	-	0.008

General anaesthesia with tracheal intubation is recommended for managing paediatric tonsillar adverse events in paediatric patients [11]. Proper selection of anaesthetic drugs and doses for paediatric patients is particularly critical. The clinical requirements for paediatric general anaesthesia are adequate analgesia, rapid onset of action and metabolism, preservation of physiological reflexes and minimal impact on circulatory and respiratory function [12]. Sevoflurane is a commonly used inhalation anaesthetic agent for induction and maintenance of anaesthesia during paediatric surgery due to its benefits such as low blood gas distribution coefficient, rapid induction of anaesthesia and postoperative recovery, easy adjustability of anaesthesia depth, and low respiratory tract irritation [13]. Furthermore, it distributes evenly across the alveolar mucosa and significantly improves the absorption efficiency, thereby stabilising the patient's intraoperative haemodynamic parameters [14]. Moreover, it does not increase the risk of postoperative respiratory complications [15].

Rifentanil is a clinical opioid agonist with a rapid onset of action, good analgesia and a unique metabolic profile that allows for sustained extrahepatic hydrolysis by non-specific esterases [16]. The elimination half-life of plasma concentrations after discontinuation is only 3 - 5 min, which provides good circulatory stability, controllability and non-accumulation [17]. It has been observed that the metabolism, volume of drug distribution and clearance of remifentanil are negatively correlated with the age of the patient [18]. In this study, patients in the control group received propofol, while those in the study group were treated with remifentanil/sevoflurane. The results indicated better anaesthetic effects produced by remifentanil/sevoflurane than propofol alone. Patients administered with remifentanil plus sevoflurane experienced significantly shorter time-elapsed before postoperative recovery of spontaneous breathing, consciousness, and extubation than those with propofol. The results of this study were similar to those of previous studies [19,20]. This suggests that the dual drug regimen of remifentanil and sevoflurane was significantly better than propofol for general anaesthesia

lesions in order to ensure the smooth performance of surgery and reduce the risk of induction in paediatric patients undergoing tonsil surgery.

Furthermore, the incidence of postoperative adverse reactions in the study group was significantly lower than that in the control group. Also, treatment satisfaction in the study group was significantly better than that in the control group. These findings provide additional evidence that the use of both remifentanil and sevoflurane is a reliable method for maintaining the patient's respiratory and circulatory stability during paediatric tonsil surgery. This anesthetic regimen provides a quicker and safer recovery for the patient and reduces the risk of postoperative complications. Ultimately, this approach is likely to enhance the family's satisfaction with the clinical care received.

CONCLUSION

Administration of combined remifentanil/sevoflurane anaesthesia is more effective than propofol anaesthesia in paediatric patients undergoing tonsil surgery. The combination facilitates the maintenance of intraoperative haemodynamic stability and postoperative recovery and reduces the risk of postoperative adverse events.

DECLARATIONS

Acknowledgements

None provided.

Funding

None provided.

Ethical approval

None provided.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the correspon-

ding author on reasonable request.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them. Chao Pan and Yahui Xing have equal contribution to this study.

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