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Comparison of alfentanil and fentanyl in painless colonoscopy in children

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Abstract

Objective To explore the safety and efficacy of alfentanil and fentanyl combined with propofol in painless colonoscopy in children. **Methods** 60 children aged 3-7 years old who were going to do colonoscopy in our hospital were randomly divided into alfentanil group (AF group) and fentanyl group (F group), with 30 cases in each group. The dosage of alfentanil 10ug/kg and fentanyl 2ug/kg respectively were used in both groups. The recovery time, induced cough, vital signs, physical activity, drug supplementation, postoperative adverse reactions and doctor satisfaction of the two groups of children were observed and recorded. **Results** The recovery time of AF group was shorter than that of F group, which was (11.40±4.33) minutes and (9.37±2.81) minutes respectively ($P< 0.05$). The induced cough in AF group was less than that in F group ($P< 0.05$). AF group had more body motion than F group ($P< 0.05$). There were no significant differences in blood pressure, heart rate, oxygen saturation, respiratory rate and other vital signs between the two groups ($P> 0.05$), but the values of vital signs at all observation points in the two groups were lower than those before anesthesia. No adverse reactions occurred in the two groups, and there was no significant difference in the satisfaction of doctors between the two groups. **Conclusion** Both alfentanil and fentanyl can be effectively used in painless colonoscopy in children. However, alfentanil is more suitable for painless colonoscopy than fentanyl due to its shorter resuscitation time, lower incidence of induced cough and no increased risk of adverse reactions.

Keywords alfentanil; fentanyl; Pediatric anesthesia; Painless enteroscopy; Recovery time; choking; body movement

Catherine Kukbar et al.[1] first proposed the theory of "comfort medicine" in 1992, which refers to the physical and mental comfort obtained by patients when they seek medical treatment. Comfort medicine can reduce patients' pain and discomfort and reduce complications.

"Comfort medicine" is widely used for various invasive procedures, such as intravenous infusions, intramuscular injections, and outpatient invasive examinations. It is also widely used in day surgery and inpatient surgery[2]. At present, electronic colonoscopy has become the most intuitive and commonly used method of examination, and it is gradually being widely used in children's full-length colon examinations[3]. The diagnostic rate of electronic colonoscopy for lower gastrointestinal bleeding in children can reach 80.7% to 87.5%[4]. It can not only intuitively and effectively detect the lesion site but also perform biopsy, titanium clip hemostasis, polyp excision, etc., at the lesion site.

The traditional examination method is discouraged due to the discomfort caused by its invasiveness, such as fear, arrhythmia, gastrointestinal bleeding, or perforation, which delays the treatment of the disease in most patients. Especially when children need to undergo colonoscopy, the anxiety of separation from parents, fear of the unknown, low tolerance to colonoscopy discomfort, and inability to cooperate effectively with medical personnel make it difficult for ordinary colonoscopy to be used in children, increasing the necessity of painless diagnosis and treatment.

With the development of sedation methods and anesthesia technology, the use of propofol combined with opioid analgesics in painless gastroenteroscopy is increasing[6]. This method has good sedative and analgesic effects, which can not only relieve the patient's anxiety and reduce the adverse reactions during the examination process but also enable early detection of the disease and early intervention.

The 2018 Practice Guidelines for Moderate Sedation and Analgesia in the United States recommend that fentanyl, alfentanil, remifentanil, morphine, and nabuphine can be used for non-general anesthetic analgesia to maintain spontaneous breathing[7]. At present, propofol, sufentanil, fentanyl, and dexmedetomidine are used to induce and maintain sedation in pediatric gastroenteroscopy[8,9,10].

The above anesthetic drugs still have problems in clinical application, such as the accumulation of propofol and its lack of analgesic properties; the prolonged action and respiratory depression characteristics of sufentanil; the rapid infusion of dexmedetomidine slowing down the heart rate; and fentanyl's rapid induction of chest and abdominal stiffness and choking cough reactions, which are prone to delayed respiratory depression and other adverse reactions. There is an urgent need for a drug that induces smooth, rapid onset and rapid recovery.

As a derivative of fentanyl, alfentanil is a highly effective and fast-acting opioid □-receptor agonist. It takes effect in 30 seconds and reaches its peak effect in 1-2 minutes, and its maintenance time is usually only 10-15 minutes. It is very suitable for anesthesia sedation and analgesia outside the operation[11]. The degradation products of alfentanil have little opioid activity.

According to statistics, the use of alfentanil is led by the United Kingdom, and it is widely used in day surgery centers, endoscopic centers, and outpatient minor surgeries[12]. The European Association of Pediatric Anesthesiologists pointed out in the guidelines for pediatric perioperative

pain management that minor surgeries in minors can safely use alfentanil, and the combination of slightly larger doses of alfentanil and intravenous anesthesia drugs such as propofol can meet the induction of general anesthesia in tracheal intubation in minors[13]. At present, domestic and foreign studies have shown that alfentanil is widely used in adult gastroscopy, burn dressing change, pediatric hernia, and other minor surgeries[14,15,16].

The purpose of this trial is to explore the comparative study of the safety and efficacy of alfentanil and fentanyl in pediatric painless colonoscopy and to provide a new medication reference for pediatric colonoscopy.

1 Materials and methods

1.1 General Information

Sixty children aged 3-7 who were enrolled in our hospital for colonoscopy. After signing the informed consent form according to the process, they were divided into AF group and F group by random number table method. Among them, 17 boys and 13 girls in AF group; average age (71.30±20.09) months; average body mass index (20.95±1.58) kg/m^2; duration of anesthesia (17.77±3.09) min; duration of operation (15.73±3.16) min. In the F group, there were 16 boys and 14 girls; average age (68.03±18.55) months; average body mass index (20.84±1.49) kg/m^2; duration of anesthesia (17.43±3.45) min; duration of operation (15.37±3.40) min. There was no statistical difference in general data between the two groups (P>0.05). The ethics committee of Shenzhen Children's Hospital approved the trial (approval number: 2021090).

1.2 Inclusion and Exclusion Criteria

Inclusion Criteria

- Age 3-7 years old, BMI value 18-24 kg/m^2;
- Gender is not limited;
- American Society of Anesthesiologists (ASA) level I-II.

Exclusion Criteria

- Preoperative use of sedative and analgesic drugs;
- Patients with upper respiratory tract infection and unstable asthma before operation;
- Hypertrophy of tonsils and adenoids causing different degrees of airway obstruction;
- Severe hepatorenal dysfunction;
- Family members who disagree.

Termination Criteria

- Severe respiratory depression, requiring airway support;
- Severe tracheobronchial and bronchial spasm requiring medical intervention.

1.3 Drugs and Equipment

- Jing'an Propofol Emulsion Injection, Specification: 20ml, 0.2g, Approval Number: Sinopharm Zhunzi HJ20170305, produced by Fresenius Kabi Austris GmbH, sub-packaged by Beijing Fresenius Kabi Pharmaceutical Co., Ltd.;
- Alfentanil Hydrochloride Injection, Ruijixin, Specification: 2ml: 1mg, Approval Number: Sinopharm Zhunzi H20203054, Yichang Renfu Pharmaceutical Co., Ltd.;
- Fentanyl Citrate Injection, Forfen, Specifications: 2ml: 0.1mg, Approval Number: Sinopharm Zhunzi H42022076, Yichang Renfu Pharmaceutical Co., Ltd;
- The monitor is the Philips Patient Monitor MP40/50.

1.4 Methods of Anesthesia

Before the operation, the children were asked to fast for 8 hours and abstain from drinking for 2 hours to fully improve the preoperative preparation. Connect the monitor and Narcotrend (NT), and inhale oxygen at 5L/min from the mask. The AF group was slowly injected with propofol 2.5mg/kg and alfentanil 10μg/kg. The F group was slowly injected with propofol 2.5mg/kg and fentanyl 2μg/kg. After the children fell asleep quietly, both groups continued to pump propofol 4-6mg/kg/min. The operation started when the stable NT value was 79-65. According to whether the children had physical movement during the inspection operation, or when the NT value was >79, propofol 1mg/kg was injected at a single time. Blood pressure (BP), heart rate (HR), blood oxygen saturation (SpO_2), and respiratory rate (RR) were monitored during enteroscopy. Data of each observation point were collected and recorded (basic value T0, 1.5 min T1 after administration, T2 at the beginning of operation, T3 in the liver area, T4 at the end of the operation, T5 at the end of the operation, and T6 at the time of leaving the chamber). Record the induced cough (no choking cough, mild, moderate, and severe four grades). At the same time, record the physical movement (grade 0, grade 1, grade 2, grade 3) and respiratory depression during enteroscopy. And the concentration of propofol pumped and the number of additional propofol in the AF group and the F group. If severe respiratory depression, bradycardia, or bronchospasm occurs during the examination, the test will be terminated immediately, and corresponding measures will be taken to actively deal with it. After colonoscopy, the time of recovery (steward score ≥4), the operator's satisfaction with the examination process, and the occurrence of postoperative adverse reactions (nausea, vomiting, respiratory depression) were recorded.

1.5 Observation Metrics

Main Indicators:Record the wake-up time (from the end of the operation to the time of departure from the room).

Secondary Indicators:BP, HR, SpO_2, and RR were recorded at each observation point. Choking cough reaction during induction, number of intraoperative movements, number of additional propofol, doctor satisfaction, and postoperative adverse reactions (nausea, vomiting, respiratory depression) were used to evaluate whether alfentanil was superior to fentanyl in pediatric painless colonoscopy.

1.6 Statistical Methods

SPSS 25.0 software was used for statistical analysis. Continuous variables were represented by (mean ± standard deviation), and two independent samples T-test was used for comparison between groups. Repeated measurement data were analyzed by repeated measurement variance, and a spherical test was performed. If it did not meet the spherical test, Greenhouse-Geisser results were used. P<0.05 was considered to be statistically significant.

2 Results

2.1 General Information

There were no statistical differences in age, gender, BMI, operation duration, and anesthesia duration between the two groups (P>0.05), as shown in Table 1.

Table 1 Comparison of general data of two groups of patients

Variable	F (n=30)	AF (n=30)	t/Z/X^2	P
Ages（M）	68.03±18.55	71.30±20.09	0.654[a]	0.516
BMI（kg/m^2）	20.84±1.49	20.95±1.58	0.286[a]	0.776
Sex				
Male	16	17	0.067[c]	0.795
Female	14	13		
Surgery duration(min）	15.37±3.40	15.73±3.16	0.433	0.667
Anesthesia duration (min)	17.43±3.45	17.77±3.09	0.394	0.695

Note: Exact probability method, no statistics; a is t-value, b is Z-value, c is X^2-value

2.2 Effectiveness indicators

2.2.1 The resuscitation time of the two groups, the resuscitation time of the patients in the alfentanil group was shorter than that in the fentanyl group (P<0.05), as shown in Table 2.

Table 2. Comparison of resuscitation time between two groups of patients

Group	Number of cases	Recovery time（min）
F	30	11.40±4.33
AF	30	9.37±2.81
t		2.158
P		0.036

2.2.2 Comparison of Mean Arterial Pressure at Different Treatment Time Points in Two Groups of Patients

The mean arterial pressure of patients in the two groups changed over time, as shown in Figure 1. The pulse pressure at T1, T2, T3, T5, and T6 in the fentanyl group decreased compared to T0 (P<0.05), while the pulse pressure at T4 had no statistical significance compared to T0 (P>0.05). The pulse pressure at T1, T2, T3, T4, T5, and T6 in the alfentanil group decreased compared to T0 (P<0.05). There was no statistical significance in the effect of pulse pressure between the two groups (group F = 0.055, P>0.05). There was no statistical significance in the interaction effect between pulse pressure and time between the two groups ($F_{time \times group}$ = 0.311, P>0.05). See Table 3 for details.

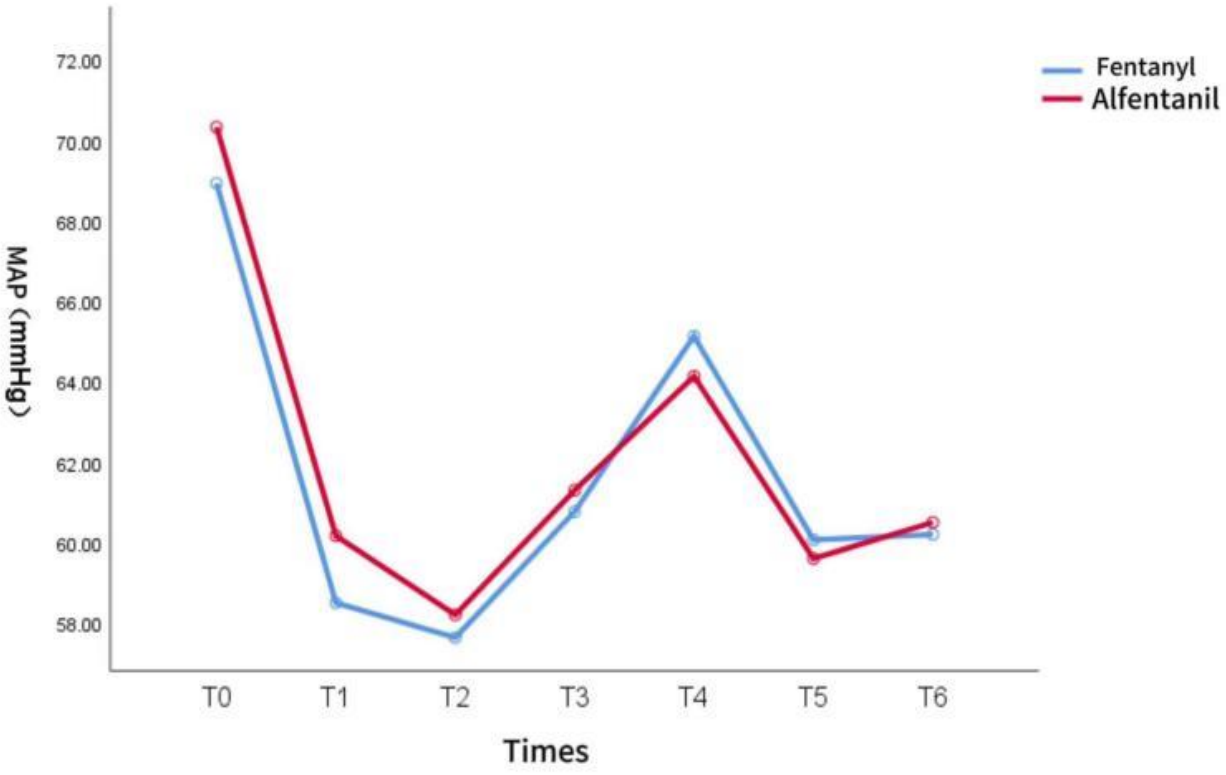
Table 3 Comparison of mean arterial pressure between the two groups at different time points

Group	N	MAP（mmHg）							F_T	F_G	$F_{T\times G}$
		T0	T1	T2	T3	T4	T5	T6			
F	30	68.93±9.71	58.50±6.61*	57.63±8.01*	60.77±6.72*	65.13±11.97	60.07±7.57*	60.20±6.70*	22.526	0.055	0.311
AF	30	70.33±9.12	60.17±10.94*	58.20±10.13*	61.30±9.78*	64.13±12.74*	59.60±8.42*	60.50±9.46*			
t		0.576	0.714	0.24	0.246	0.313	0.226	0.142			
P		0.567	0.478	0.811	0.806	0.755	0.822	0.888	<0.001	0.815	0.857

Note: In the intra-group comparison, **P*<0.05 compared with T0

2.2.3 The Comparison of Heart Rate Between the Two Groups at Different Treatment Time Points

The comparison of heart rate between the two groups at different treatment time points showed that the time effect had statistical significance (F_{time}=37.824, P<0.001), and the heart rate of the two groups decreased over time, as shown in Figure 2. The heart rate at T1, T2, T3, T4, T5, and T6 time points in both groups decreased compared to T0 (P<0.05). There was no significant



difference in heart rate between the two groups (group F = 0.534, P>0.05). There was no statistical significance in the interaction effect between heart rate and time between the two groups ($F_{time \times group}$ = 0.505, P>0.05). See Table 4 for details.

Table 4 Comparison of heart rate between the two groups at different treatment time points

Group	N	HR（times/min）							F_T	F_G	$F_{T\times G}$
		T0	T1	T2	T3	T4	T5	T6			
F	30	98.83±9.91	86.07±9.48*	84.57±8.81*	85.37±8.18*	88.93±10.20*	86.40±7.53*	86.90±8.32*	37.824	0.534	0.505
AF	30	98.13±13.20	88.43±8.01*	85.83±7.10*	87.03±7.09*	89.57±7.98*	88.30±5.97*	88.73±4.70*			
t		0.232	1.044	0.613	0.843	0.268	1.083	1.051			
P		0.817	0.301	0.542	0.403	0.790	0.283	0.299	<0.001	0.468	0.638

2.2.4 Comparison of Respiratory Rate Between the Two Groups at Different Treatment Time Points

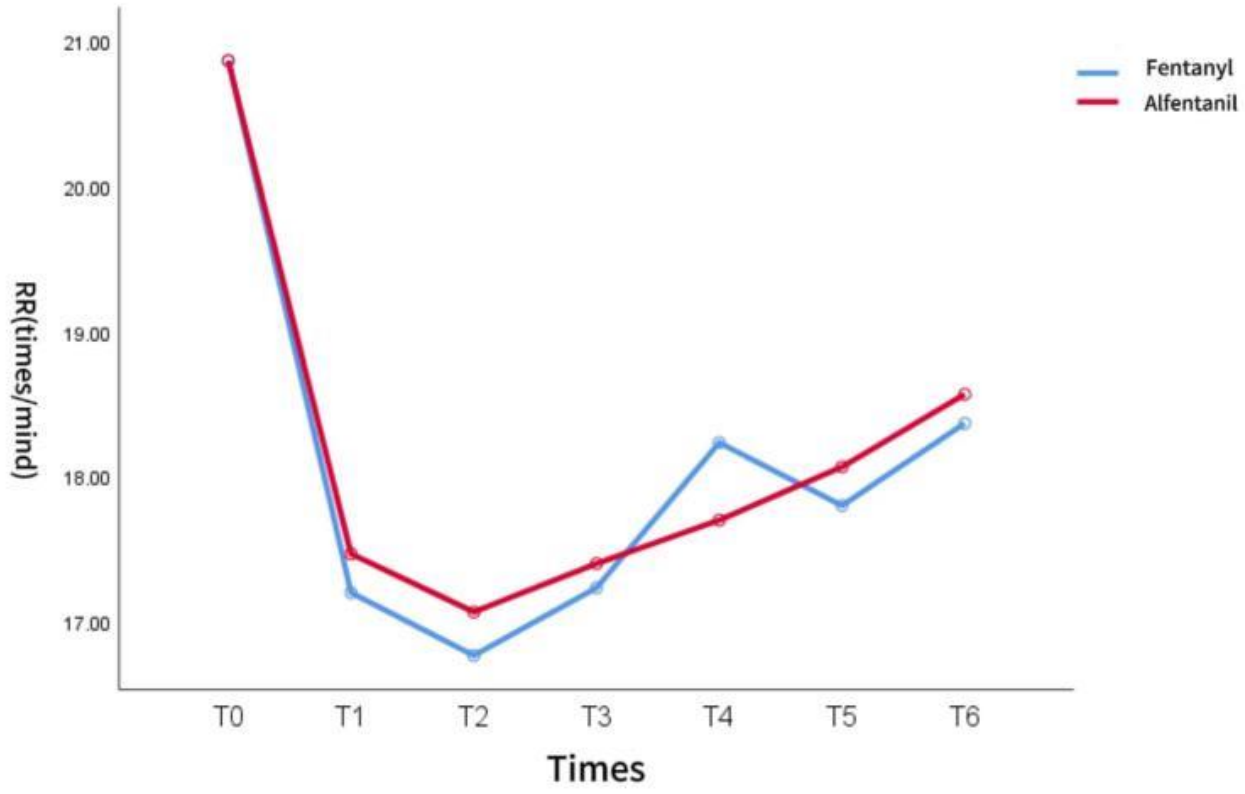
The results showed that the time effect was statistically significant (F_{time} = 36.434, P<0.001), and the respiratory rate of patients in the two groups decreased over time, as shown in Figure 3. The

respiratory rate at T1, T2, T3, T4, T5, and T6 in both groups decreased compared to T0 (P<0.05). There was no significant difference in respiratory rate between the two groups (group F = 0.029, P>0.05). There was no statistical significance in the interaction effect between respiratory rate and time between the two groups ($F_{time \times group}$ = 0.455, P>0.05). See Table 5 for details.

Table 5 Comparison of respiratory rate between the two groups at different treatment time points

Group	N	RR（times/min）							F_T	F_G	$F_{T\times G}$
		T0	T1	T2	T3	T4	T5	T6			
F	30	20.87± 2.21	17.20± 3.17*	16.77± 3.15*	17.23± 2.73*	18.23± 2.62*	17.80± 2.91*	18.37± 2.81*	36.434	0.029	0.455
AF	30	20.87± 1.98	17.47± 2.32*	17.07± 3.14*	17.40± 2.24*	17.70± 2.55*	18.07± 2.61*	18.57± 2.50*			
t		<0.001	0.372	0.37	0.259	0.799	0.374	0.291			
P		>0.999	0.711	0.713	0.797	0.428	0.710	0.772	<0.001	0.864	0.775

Note: In the intra-group comparison, compared with T0, * $P < 0.05$



2.3 Safety Metrics

There were no serious adverse reactions in either group. Four cases of induced choking cough occurred in group F, all of which were mild and resolved on their own without special intervention. There was no significant decrease in pulse oxygen saturation during the period, and there was no choking cough in the AF group. There were 12 cases of physical activity in group F and 16 cases in the AF group, most of which were first-order physical activity. Most patients did not need additional propofol; however, the number of additional propofol doses in the AF group was higher than in the F group. After adding propofol, the surgical conditions were satisfactory. The number of additional propofol doses in the AF group and the F group did not conform to a normal distribution and was expressed as the median (quartile). There was no significant difference between the two groups in this regard, and no significant difference in doctor satisfaction between the two groups. See Table 6 for details.

Table 6 Comparison of clinical characteristics of two groups of patients

Variable	F (n=30)	AF (n=30)	t/Z/X^2	*P*
Induced choking cough (times)				
0	26（86.6）	30（100.0）	2.444	0.038
Mild（1-2times）	4（13.3）	0（0.0）		
Moderate（3-4times）	0（0.0）	0（0.0）		
Severe（≥5times）	0（0.0）	0（0.0）		
Body dynamic response rating (grade)				
0	18（60.0）	14（46.7）	4.286	0.018
1	11（36.7）	13（43.3）		
2	1（3.3）	3（10.0）		
3	0（0.0）	0（0.0）		
Number of times to add propofol (times)	0(0,1)	1(0,1)	0.695[b]	0.487
Doctor satisfaction (example)				
Satisfied	29	30	1.017	0.313
Dissatisfied	1	0		

3 Discussions

3.1 Efficacy and Dosage of Alfentanil and Fentanyl

Afentanil, a derivative of fentanyl, is a fast-acting and highly effective opioid μ receptor agonist. Some studies have pointed out that the application of afentanil combined with propofol during gastroenteroscopy not only has the characteristics of rapid onset, good analgesic and sedative effects, and fast recovery, but also can significantly reduce the adverse irritation of patients during the examination, thus enabling the smooth conduct of the examination[17]. Fentanyl is a commonly used analgesic in gastroenteroscopy in our hospital, and the empirical dose is often 2 μg/kg when combined with propofol. The analgesic efficacy ratio of alfentanil to fentanyl is about 15:100[18], so the equivalent dose of alfentanil that can be applied is about 13 μg/kg. According to pre-test observation and adjustment, and some articles pointed out that the recommended dosage of alfentanil when combined with propofol used in colonoscopy was 10 μg/kg[19], the dosage of alfentanil was finally determined to be 10 μg/kg.

The market availability of alfentanil in China is relatively recent, and the research data is relatively insufficient. Propofol, a commonly used intravenous anesthetic in the clinic, is a GABA receptor agonist, which mainly activates GABA-chloride ion receptors and enhances the inhibition of GABA to inhibit the excitability of neurons, thus producing sedative and hypnotic effects. Studies have pointed out that alfentanil has the effect of maintaining moderate sedation in the emergency department and is comparable to propofol[11]. Therefore, when using afentanil (10 μg/kg) combined with propofol, the dosage of propofol can be adjusted as needed[20]. In this study, 2 μg/kg fentanyl and 10 μg/kg alfentanil combined with propofol were used for painless colonoscopy in children.

3.2 Comparison of General Data

There were no significant differences in age, sex, BMI, anesthesia duration, and operation duration between the two groups ($P>0.05$).

3.3 Recovery Time and Metabolic Characteristics

The recovery time of patients in the alfentanil group was shorter than that in the fentanyl group ($P<0.05$), which was related to the metabolic characteristics of alfentanil. Alfentanil binds to plasma proteins (mainly glycoproteins) up to 90% of the time, which is higher than fentanyl. With a pKa of 6.5, 90% of alfentanil is in the non-dissociated form at physiological pH. So there are more dissolved parts of alfentanil than fentanyl. This is the reason why alfentanil has a short time to reach peak effect after intravenous injection, and it is also the reason why its metabolic degradation is fast[12]. This is inconsistent with the results of a randomized double-blind clinical trial conducted by Wai-Meng Ho et al.[21], which showed no significant difference in sedation and recovery time of fentanyl and alfentanil combined with propofol in colonoscopy. The reason for the inconsistent results may be related to the difference in dose or age distribution of the drugs in the two trials. Drug clearance is inseparable from pharmacokinetics, which is a key factor in the transition of drug efficacy and safety from adults to children[22]. Over the years,

many methods have been proposed to calculate pediatric dosage and drug clearance. While some recommendations are useful for predicting dosage and drug clearance in children, there is still a great deal of uncertainty. In particular, the determination of dose and clearance in individual patients remains uncertain[23].

3.4 Circulatory System Analysis

From the perspective of circulation analysis, this experiment showed that both alfentanil and fentanyl could be effectively used for painless colonoscopy in children. BP, HR, and RR in the two groups during the examination were lower than those before anesthesia ($P<0.05$), but there was no significant difference between the two groups at each observation point ($P>0.05$). This indicates that the hemodynamics and other indicators of alfentanil in children are safe and reliable and do not increase the probability of adverse reactions. The blood pressure and heart rate of the two groups were basically the same at each collection time point, and there was no significant difference in the effects of the two groups on the circulatory system. The basic measurement values of children in both groups were significantly higher than those at other time points, so it can be considered that the anesthesia program in both groups was successful and effective. Opioids can increase the sensitivity of cardiomyocytes to Ca^{2+}, thus enhancing the contractility of cardiomyocytes and stabilizing the circulatory system. Therefore, this change of circulatory system may also be related to the cyclic inhibition of propofol. From the aspect of circulatory system, both anesthesia protocols can be safely applied to pediatric colonoscopy.

3.5 Respiratory System Analysis

From the perspective of respiratory analysis, the walking trend of respiratory rate in the two groups was similar to that in the circulatory system, and the basic measurement value at the time of entry was higher than other measurement time points. The difference is that the lowest value is located immediately after intravenous administration of opioids (alfentanyl or fentanyl) (T1), and then slowly rises. Li Na et al.[24] have shown that alfentanil can inhibit neurons in the dorsal side of the pons, and the spontaneous potential activity of these cells is related to the regulation of respiratory rhythm frequency, resulting in the decrease of respiratory frequency and the risk of insufficient ventilation. Some foreign researchers have indicated that combined molecular model studies have shown that respiration of fentanyl may also be related to the inhibition of □1A- and □1B-adrenergic receptors[25]. In this trial, although the respiratory rate decreased after the application of alfentanil and fentanyl, the blood oxygen saturation of the children in the two groups did not decrease significantly during the electronic colonoscopy and the resuscitation stage by inhaling oxygen with a flow mask of 5L/min. The respiratory rate of all children was assessed to have recovered to the preoperative level when they left the recovery room. From the perspective of respiratory system, both anesthesia protocols can be safely applied to electronic colonoscopy in children.

3.6 Body Movements and Additional Propofol

In this study, the alfentanil group had more body movements than the fentanyl group (P<0.05), which was consistent with the experimental report that the sedative and analgesic effect of fentanyl combined with propofol in colonoscopy was better than that of alfentanil combined with propofol[26]. The reason for the above results may be related to the small dosage of alfentanil selected in the trial. As mentioned above, according to the analgesic efficacy ratio of the two drugs, the equivalent dosage of alfentanil should be about 13 μg/kg, while the actual dose selected is 10 μg/kg. Colonoscopy will produce colic with the depth of the lens, which shows that there is still a certain need for analgesia during colonoscopy.

The experimental results showed that the number of additional propofol doses in the alfentanil group was more than that in the fentanyl group (P>0.05), and the data showed that the number of additional propofol doses due to body motion reaction was not large, but the actual number of additional propofol doses in the alfentanil group was not small. During the design of the experiment, the additional number of propofol doses was not only related to body motion but also related to NT value >79. It can be seen that the same children in both groups needed multiple doses, and the NT value >79 also required additional drugs, and there was no significant difference in the number of times of propofol supplementation between the two groups. Due to the limited sample size, the results of intraoperative body movement and drug addition times need to be further verified.

3.7 Incidence of Adverse Events

In addition to fluctuations in circulatory and respiratory rates and rhythms, the incidence of adverse events is also of concern. Although the popularity of painless colonoscopy has increased in recent years, and the incidence of complications caused by stress reactions due to anxiety and tension and intraoperative pain has decreased significantly, the application of anesthetic drugs may also bring some side effects or adverse reactions. Studies have shown that adverse reactions related to the use of anesthetic drugs during painless gastroenteroscopy may include hemodynamic fluctuations, arrhythmia, decreased pulse saturation, apnea, postoperative nausea and vomiting, reflux aspiration, masseteric spasm, headache, delirium, myocardial infarction, death, etc.[27-28]. The appropriate anesthesia regimen needs to meet the comfort of gastroenteroscopy while minimizing the risk of adverse reactions. Respiratory-related adverse reactions of opioids are often related to □ receptors, and hypoxic-related adverse events are more likely to occur in children when respiratory function is inhibited due to poor oxygen reserve compared with adults. Therefore, the effects on the respiratory system should be considered when selecting analgesic drugs in electronic colonoscopy.

3.8 Safety and Satisfaction

In this experiment, 4 cases of children with cough occurred during the operation, all of them occurred in group F, the degree was mild, and without special treatment, the children quickly

recovered by themselves, and there was no obvious fluctuation of pulse oxygen saturation during the period. These results indicated that both groups of anesthesia protocols were safe and reliable in the application of colonoscopy in children, while no respiratory-related adverse events occurred in the AF group in this trial, indicating that alfentanil was safer than fentanyl in the two groups of anesthesia protocols.

There was no significant difference in endoscopists' satisfaction with anesthesia protocols between the two groups. The following reasons were considered: On the one hand, the evaluation completely depended on the subjective will of endoscopists, and there were no objective indicators. On the other hand, both anesthesia protocols can be effectively applied to colonoscopy, although the body movements of the two groups are slightly different during the examination, but most of them are grade 1 body movements. A small number of patients with grade 2 body motion could complete the examination after timely addition of propofol. The depth of sedation and analgesic intensity in the test met the examination needs, and endoscopists were satisfied with the two anesthesia schemes.

3.9 Limitations of the Study

The shortcomings of this study include: 1. This trial only studied the use of alfentanil and fentanyl in a very small group of children aged 3 to 7 years. Different age groups such as newborns, infants, and school-aged children were not studied separately, so it is unclear whether the trial results apply to children of all ages. 2. This trial did not set up a drug concentration layer, and failed to fully understand the safety and efficacy of different drug doses in painless colonoscopy in children. And only the medication situation when receiving painless electronic colonoscopy was studied. 3. This study was only conducted in our hospital, and did not conduct multi-site, multi-group, and other multi-center studies. The conclusions obtained may be biased due to different equipment, drugs, and operators.

4 Conclusion

In summary, alfentanil and fentanyl combined with propofol anesthesia can be effectively applied to pediatric painless colonoscopy, but because alfentanil has a short recovery time, a low incidence of cough, and does not increase the risk of adverse reactions, it is more suitable for pediatric painless colonoscopy than fentanyl.

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