

Randomized Double-Blind Controlled Clinical Study of Ciprofol and Propofol in Patients with Painless Artificial Abortion

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Abstract

Background and Objectives: Propofol is a commonly used intravenous anesthetic for painless artificial abortion, but the injection pain and related adverse reactions such as those related to respiration and circulation it induces have also been criticized. We aimed to conduct a comparative study on the efficacy, safety and comfort of ciprofol and propofol applied in painless artificial abortion. **Materials and Methods:** A total of 140 early pregnant patients undergoing painless induced abortion were selected and randomly divided into the ciprofol combined with fentanyl group (Group C) and the propofol combined with fentanyl group (Group P), with 70 cases in each group. The anesthetic effect, depth of anesthesia sedation (NI), onset time, recovery time, recovery time of orientation, retention time in the anesthesia recovery room and total amount of intravenous anesthetic drug were recorded in both groups. The respiratory rate (RR), oxygen saturation (SpO₂), mean arterial pressure (MAP), and heart rate (HR) at different time points were recorded. The occurrence of perioperative adverse events, injection pain, postoperative nausea and vomiting, and dizziness were compared. The pain score at 30 minutes after operation and the satisfaction of patients and surgeons with anesthesia were evaluated. **Results:** The success rate of anesthesia in both groups was 100%. There were no statistically significant differences in the NI value at each time point, intraoperative body movement, recovery time, recovery time of orientation, retention time in the anesthesia recovery room, and total dosage of sedative drugs (ml) between the two groups; the onset time in Group C was longer than that in Group P, with a statistically significant difference ($P < 0.05$); the respiratory depression, hypoxemia, hypotension, and injection pain in Group C were lower than those in Group P, with statistically significant differences ($P < 0.05$). The satisfaction of patients with

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anesthesia in Group C was higher than that in Group P, with a statistically significant difference ($P < 0.05$). There were no statistically significant differences in postoperative nausea and vomiting, dizziness, and the satisfaction of surgeons with anesthesia between the two groups. **Conclusion:** The efficacy of ciprofol in painless induced abortion is equivalent to that of propofol, and the incidence of adverse reactions is lower than that of propofol, with higher safety and comfort.

Keywords

Ciprofol, Propofol, Fentanyl, Artificial Abortion, Anesthesia

1. Introduction

Comfortable medical care pursues painlessness and comfort, and painless induced abortion is one of its important practices in the field of obstetrics and gynecology. Painless induced abortion reduces the physical pain and psychological burden of patients, providing a more humanized option for women [1]. Before the listing of ciprofol, propofol was a commonly used intravenous anesthetic for short surgeries in obstetrics and gynecology outpatient clinics such as painless induced abortion, painless oocyte retrieval, and painless hysteroscopy due to its advantages of rapid onset, short duration of action, quick recovery, and complete awakening [2]. However, propofol also has some drawbacks, such as inhibitory effects on the patient's breathing and circulation, usually manifested as apnea, heart rate slowing, blood pressure drop, etc. [3]; it also causes adverse reactions such as injection pain and postoperative restlessness [2]-[4]. Ciprofol is a domestically initiated type I new intravenous anesthetic. It introduces a cyclopropyl group on the chemical structure of propofol, thus having higher selectivity. Its affinity for GABA receptors is about 5 times that of propofol. It has characteristics such as rapid onset, quick recovery, high potency, and less injection pain, and has high clinical application value [5] [6]. Based on this, this study applied ciprofol and propofol in painless induced abortion and conducted a randomized, double-blind comparative observation on their effectiveness, safety, and comfort, hoping to find a better anesthesia plan for clinical anesthesia.

2. Materials and Methods

2.1. General Information

This study was approved by the Hospital Ethics Committee (Ethical Review No. YJ202384), and patients or their families signed the informed consent form. The study subjects were 140 early pregnant patients who underwent painless induced abortion at the First Affiliated Hospital of Yangtze University from January 2024 to March 2024. They were divided into the ciprofol group (Group C) and the propofol group (Group P) according to the random number table method, with 70 cases in each group. Inclusion criteria: 1) Age 18 - 50 years old, ASA grade

I-II, BMI 18 - 30 kg/m²; 2) Accurate and complete clinical data; 3) Patients were intrauterine early pregnancy by imaging examination and met the indications of painless induced abortion; 4) No dysfunction of important organs such as heart, lung, liver and kidney, and no shock; 5) Normal mental state, no drug addiction and language communication disorder; 6) No history of allergy to propofol; 7) With the ability to read and understand, informed of this study and willing to participate. Exclusion criteria: 1) Those who refused to participate or were not suitable to participate in this trial; 2) Those who were allergic to eggs, beans, opioids, propofol, etc. in the past; 3) Patients with combined severe organ dysfunction, ASA grade III or above; 4) Patients with paroxysmal sleep apnea syndrome and asthma; 5) Those with mental, language and behavioral dysfunction; 6) Those who took sedatives or opioids recently.

2.2. Anesthesia Method

All patients underwent anesthesia pre-evaluation at least one day in advance and signed the informed consent form. They were strictly fasted for 8 hours and prohibited from drinking for 4 hours before the operation. After entering the outpatient operating room, the dorsal hand vein channel was opened. The patients took the lithotomy position. ECG, MAP, HR, RR, SpO₂ and NI values were routinely monitored, and pure oxygen at 4 L/min was inhaled through the nasal catheter. After ensuring the patency of the intravenous channel, patients in both groups were intravenously injected with fentanyl 1.5 ug/kg for pre-analgesia in advance. 3 minutes later, Group C was intravenously pumped (pumping speed 1200 ml/h) with ciprofol 0.5 mg/kg (0.2 ml/kg), and Group P was intravenously pumped with propofol 2 mg/kg (0.2 ml/kg) at the same speed. If the induction was not successful within 2 minutes after administration or the patient had body movement during the operation and it affected the surgical operation, additional drugs were given. Group C was given an additional ciprofol 0.25 mg/kg (0.1 ml/kg), and Group P was given an additional propofol 1 mg/kg (0.1 ml/kg), all by intravenous pumping, and the pumping speed was 1200 ml/h. When the patient's eyelash reflex disappeared, the MOAA/S score was ≤ 1 and the NI value dropped below 64, the surgical operation was started. During the study, the vital signs of the patients were closely monitored. Ephedrine 6 mg was intravenously injected when hypotension occurred (MAP < 60 mmHg or <20% of the baseline value), atropine 0.3 mg was immediately given when bradycardia occurred (heart rate < 50 beats/min), and the mandible was lifted and pressurized oxygen was given through a sealed mask in time when respiratory depression (respiratory wave disappeared and there was no ups and downs in the chest and abdomen for more than 30 seconds) and hypoxemia (SpO₂ dropped to 90% for 10 seconds) occurred. During the process of induced abortion, if the number of additional drugs within 10 minutes after the first injection of sufficient ciprofol or propofol was ≤ 2 and the NI value was less than 64 and the MOAA/S score was ≤ 1 within 1 minute after the additional drug administration, it was recorded as

successful sedation; otherwise, it was recorded as sedation failure. The entire study was performed by the same surgeon. At the same time, another anesthesiologist observed the patient's response and recorded the data throughout. The patients, the surgeon and the observer were not informed of the medication plan until the study was successful and the data recording was completed.

2.3. Observation Indicators

2.3.1. Main Observation Indicators

1) Observe the sedation success rate, NI (anesthesia sedation depth) and MOAA/S score, and intraoperative body movement of patients in the two groups after medication. 2) Record RR (respiratory rate), SpO₂ (oxygen saturation), HR (heart rate), and MAP (mean arterial pressure) at different time points (upon entering the room T₀, 2 minutes after intravenous anesthetic administration and placement of the vaginal speculum T₁, during uterine aspiration T₂, and at the end of awakening T₃). 3) Record the incidence of adverse events, including respiratory depression, hypoxemia, hypotension, injection pain, postoperative nausea and vomiting, and dizziness.

2.3.2. Secondary Observation Indicators

1) Record the onset time (from the initial administration to the NI value dropping below 64 and the modified observer's assessment of alertness/sedation score MOAA/S score ≤ 1), operation time (from the placement of the vaginal speculum to the removal of the vaginal speculum), awakening time (from the last administration to the patient's consciousness recovery, stable spontaneous breathing, and ability to move according to instructions), orientation recovery time (from awakening to the ability to accurately identify the time, place and person), retention time in the anesthesia recovery room (from awakening to leaving the PACU), and the total amount of intravenous anesthetic (ml). 2) Assess the VAS (Visual Analogue Scale) pain score 30 minutes after the operation and conduct oral evaluations of the satisfaction degree of patients (from the subjective feelings of patients during induction, postoperative adverse reactions, etc.) and surgeons (from the onset time of anesthesia, the effect of anesthesia maintenance, etc.) with anesthesia (divided into three grades: satisfactory, average, and unsatisfactory).

2.4. Statistical Analysis

SPSS 25.0 software was used for analysis. The measurement data of normal distribution and approximately normal distribution were expressed as mean \pm standard deviation ($\bar{x} \pm s$), and the comparison between groups was performed by the group t-test. The variance analysis of repeated measurement data was used for the comparison before and after within the group. The measurement data of non-normal distribution were expressed as median (lower quartile, upper quartile) [M (P25, P75)], and the comparison between groups was performed by the Mann-Whitney U test. The count data were expressed as cases (%) and the

comparison between groups was performed by the χ^2 test or Fisher's exact probability method. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of General Conditions between the Two Groups

There were no statistically significant differences in general conditions such as age, BMI, ASA grade, pregnancy period, operation time and the number of induced abortions between the two groups ($P > 0.05$), and they were comparable. (Table 1)

Table 1. Comparison of general conditions between the two groups.

| Group | N | Age | BMI (kg/m ²) | ASA I/II (number) | Pregnancy period (day) | Operation time (s) | The number of induced abortions 1/2/3 |
|---------------------|----|------------|--------------------------|-------------------|------------------------|--------------------|---------------------------------------|
| C | 70 | 30.0 ± 6.0 | 23.4 ± 2.6 | 63/7 | 49.7 ± 3.2 | 321.8 ± 39.8 | 58/7/5 |
| P | 70 | 28.3 ± 5.5 | 23.7 ± 2.7 | 64/6 | 49.5 ± 3.3 | 328.5 ± 37.2 | 59/10/1 |
| <i>t</i> / χ^2 | | 1.766 | -0.777 | 0.085* | 0.362 | -1.027 | 3.205* |
| P | | 0.080 | 0.438 | 0.771 | 0.718 | 0.306 | 0.201 |

* = χ^2 .

3.2. Comparison of Effectiveness

The success rates of anesthesia sedation in both groups were 100%, and there was no statistical difference in the NI values and MOAA/S scores at each time point between the two groups. The onset time in Group C was longer than that in Group P, and the difference was statistically significant ($P < 0.05$). There were no statistically significant differences in intraoperative body movement, operation time, awakening time, orientation recovery time, retention time in the anesthesia recovery room and the total amount of sedative drugs (ml) between the two groups (Table 2).

Table 2. Comparison of onset time, operation time, awakening time, orientation recovery time, retention time in the anesthesia recovery room and the total amount of intravenous anesthetic between the two groups.

| Group | N | Onset time (S) | Operation time (S) | Awakening time (min) | Orientation recovery time (min) | Retention time in the anesthesia recovery room (min) | The total amount of intravenous anesthetic [ml, $M(P_{25}, P_{75})$] |
|---------------------|----|----------------|--------------------|----------------------|---------------------------------|--|---|
| C | 70 | 46.0 ± 6.1 | 321.8 ± 39.8 | 6.1 ± 0.4 | 15.6 ± 1.1 | 23.9 ± 1.8 | 14.0 (12.0, 16.4) |
| P | 70 | 38.0 ± 6.0 | 328.5 ± 37.2 | 6.2 ± 0.5 | 15.8 ± 1.1 | 23.7 ± 1.5 | 13.3 (11.0, 16.6) |
| <i>t</i> / <i>Z</i> | | 7.836 | -1.027 | -1.368 | -1.376 | 0.767 | 0.859* |
| P | | <0.001 | 0.306 | 0.174 | 0.171 | 0.444 | 0.390 |

* = *Z*.

3.3. Comparison of Safety

The MAP, RR and SpO₂ of patients in both groups at time point T₁ decreased compared with those at time point T₀, and the difference was statistically significant ($P < 0.05$). Moreover, when comparing between Group C and Group P, the degrees of decrease in MAP, RR and SpO₂ in Group C were smaller, and the difference was statistically significant ($P < 0.05$). At T₂ and T₃, there was no statistically significant difference in vital signs between the two groups (**Table 3**). Comparison of perioperative-related adverse events: Compared with Group P, the incidences of intraoperative respiratory depression, hypoxemia and hypotension in Group C were significantly reduced ($P < 0.05$) (**Table 4**).

Table 3. Comparison of vital signs at different time points between the two groups.

| Vital signs | Group | T ₀ | T ₁ | T ₂ | T ₃ |
|----------------------|-------|----------------|----------------|----------------|----------------|
| MAP (mmHg) | C | 89.5 ± 12.6 | 84.9 ± 10.5a | 85.3 ± 13.2a | 89.0 ± 13.7 |
| | P | 91.1 ± 12.3 | 78.8 ± 11.7ab | 80.5 ± 12.6a | 93.7 ± 14.0 |
| HR (times/min) | C | 77.3 ± 6.2 | 73.6 ± 5.4 | 74.4 ± 5.4 | 74.4 ± 5.7 |
| | P | 78.2 ± 6.1 | 74.1 ± 5.3 | 74.9 ± 5.6 | 75.0 ± 5.8 |
| RR (times/min) | C | 14.5 ± 2.3 | 12.9 ± 2.7a | 14.5 ± 2.8 | 15.4 ± 2.8 |
| | P | 14.6 ± 2.2 | 9.4 ± 3.0ab | 14.2 ± 2.5 | 15.7 ± 2.6 |
| SpO ₂ (%) | C | 99.9 ± 0.5 | 99.3 ± 1.9a | 99.6 ± 1.2 | 99.9 ± 0.2 |
| | P | 99.9 ± 0.5 | 97.9.1 ± 4.0ab | 99.5 ± 1.5 | 99.2 ± 0.3 |
| NI | C | 94.9 ± 2.0 | 43.4 ± 3.2a | 53.0 ± 3.4a | 87.8 ± 2.9a |
| | P | 95.3 ± 1.9 | 43.8 ± 2.9a | 53.3 ± 3.1a | 88.1 ± 2.8a |
| MOAA/S | C | 5 | 1.1 ± 0.2a | 2.0 ± 0.4a | 3.9 ± 0.4a |
| | P | 5 | 1.1 ± 0.3a | 2.0 ± 0.5a | 3.8 ± 0.5a |

Compared with the same group at T₀, ^a $P < 0.05$; Compared with Group C, ^b $P < 0.05$.

Table 4. Perioperative-related adverse events of patients in the two groups.

| Group | N | Intraoperative body movement [N/(%)] | Inhibition of respiration [N/(%)] | Hypoxemia [N/(%)] | Hypotension [N/(%)] |
|----------|----|--------------------------------------|-----------------------------------|-------------------|---------------------|
| C | 70 | 30 (42.9) | 7 (10.0) | 2 (2.9) | 4 (5.7) |
| P | 70 | 25 (35.7) | 19 (27.1) | 9 (12.9) | 13 (18.6) |
| χ^2 | | 0.749 | 6.802 | 4.834 | 5.423 |
| P | | 0.387 | 0.009 | 0.028 | 0.020 |

3.4. Comparison of Comfort

Compared with Group P, the incidence of injection pain in the ciprofol group was significantly reduced ($P < 0.05$). There was no statistically significant difference in the incidences of postoperative nausea and vomiting, dizziness and other

adverse reactions between the two groups. There was a statistically significant difference in the satisfaction with anesthesia between the two groups ($P < 0.05$), and there was no statistically significant difference in the VAS score 30 minutes after the operation and the satisfaction of doctors between the two groups (Table 4 and Table 5).

Table 5. Comparison of other perioperative-related adverse events, VAS score 30 minutes after the operation and satisfaction survey of patients in the two groups.

| Group | N | Injection pain [N/(%)] | Nausea and vomiting [N/(%)] | Dizziness [N/(%)] | Postoperative 30-minute VAS score (points) | Patient (N) | | Surgeon (N) | |
|------------|----|---------------------------|--------------------------------|----------------------|--|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| | | | | | | Satisfied/Average/Unsatisfied | Satisfied/Average/Unsatisfied | Satisfied/Average/Unsatisfied | Satisfied/Average/Unsatisfied |
| C | 70 | 6 (8.6) | 3 (4.3) | 6 (8.6) | 1.3 ± 0.7 | 57/12/1 | | 58/10/2 | |
| P | 70 | 46 (65.7) | 4 (5.7) | 3 (4.3) | 1.3 ± 0.8 | 43/22/5 | | 60/9/1 | |
| χ^2/F | | 48.951 | 0.001* | 0.475 | 0.326 | 7.350* | | 0.522* | |
| P | | <0.001 | >0.999 | 0.491 | 0.745 | 0.022 | | 0.856 | |

* = F .

4. Discussion

Painless-induced abortion is a relatively common day surgery in obstetrics and gynecology outpatient clinics and is also a currently effective and safe routine method for terminating early accidental pregnancies in clinical practice [7]. The sole use of intravenous anesthesia with propofol cannot effectively suppress visceral pain and postoperative uterine contractions pain caused by strong stimulation during operations such as placement of vaginal speculums, cervical dilation and uterine aspiration [8]. Currently, intravenous anesthetic propofol is usually combined with small doses of opioid analgesics [9], which can not only make patients lose consciousness during the operation but also successfully complete the operation in a safe and comfortable state. Intravenous injection of fentanyl takes effect in 1 minute, reaches the peak of analgesia in 4 minutes, and the analgesic effect can last for 30 minutes. Previous studies have shown that the combination of propofol and fentanyl for painless induced abortion can significantly enhance the sedative and analgesic effects, shorten the recovery time, and reduce the dosage and the incidence of adverse events such as injection pain [10]. Referring to previous clinical studies [5] [11] and combined with the results of the pre-experiment, this study finally chose the anesthesia plan of combining a small dose of potent opioid analgesic fentanyl (1.5 ug/kg) with intravenous anesthetics.

Although propofol has many advantages such as rapid onset, short duration of action, quick recovery, thorough awakening and less postoperative nausea and vomiting [12], and it has been widely used in clinical practice. However, it has obvious inhibitory effects on the respiratory and circulatory systems [3] [13], so it can be used safely only under the prerequisite of sufficient oxygen supply and unobstructed airways. Moreover, propofol has a strong irritating effect on blood

vessels, and the incidence of injection pain is extremely high [4], which can bring an unpleasant anesthesia experience to patients. Therefore, a better anesthesia plan is needed. Ciprofol is a domestically initiated new type of intravenous anesthetic with characteristics such as rapid onset, quick recovery and less injection pain, and its potency is 4 - 5 times that of propofol [5]. Since its listing, more and more evidence has shown that ciprofol performs better in reducing injection pain and the incidence of adverse events such as perioperative respiratory and circulatory depression [2] [14]. Since both ciprofol and propofol are emulsions, the sedative potency ratio in this study is 1:4, and the same volume (ml) is used clinically. Therefore, the random double-blind method is used to comparatively observe the effectiveness, safety and comfort of the two in painless induced abortion.

The results of this study showed that the sedation success rate of patients in both groups was 100%. There was no statistical difference in the comparison of NI value and MOAA/S score after intravenous injection and the incidence of intraoperative body movement. This is consistent with the research results of Xu Ming *et al.* [15] applying ciprofol in fiber colonoscopy in elderly patients. The research results confirmed that when ciprofol and propofol were applied in a potency ratio of 1:4 in painless induced abortion, they also had the advantages of rapid onset, short duration of action and quick awakening, and could achieve the same anesthesia effect. This may be related to the unique molecular composition of ciprofol. Ciprofol introduces a cyclopropyl group on the basis of the chemical structure of propofol to construct a chiral structure, which increases the stereoscopic effect, thereby enhancing its affinity with the GABA A receptor and ultimately enhancing the potency of ciprofol [16] [17], thereby enhancing the inward flow of chloride ions and enabling patients to quickly enter the anesthesia state. The results of this study also showed that there was no statistical difference in the awakening time, orientation recovery time, retention time in the anesthesia recovery room and the total amount of intravenous anesthetic between the two groups, which was similar to the research results of Hao Yingchun *et al.* [14] in hysteroscopic surgery. Reviewing relevant literature, it is guessed that the reason may be that there is a certain correlation between the chemical composition and atomic arrangement of ciprofol and propofol. And in terms of pharmacokinetics, they also show many similarities [16] [17]. However, the onset time of Group C was prolonged by about 8 seconds on average compared with Group P, and the result was statistically different. But in this study, in terms of the satisfaction of the surgeon with the anesthesia, there was no statistical difference between the two groups. This indicates that the surgeon believes that the two groups perform equally in terms of the onset time of anesthesia and the maintenance effect of anesthesia during the operation. Although the research results showed a certain statistical difference in the onset time, this difference was small and its clinical significance was relatively limited. Based on the above studies, indicate that the effectiveness of ciprofol is not inferior to that of propofol.

The inhibitory effect of propofol on the patient's respiratory and circulatory system is related to many factors, such as dose, injection speed, age, functions of important organs such as cardiopulmonary function and individual differences, especially the dose and injection speed. In this study, there was no statistical difference in baseline data between patients in Group C and Group P. The injection speed of both groups was the same (1200 ml/h) using an injection pump to eliminate the influence of the injection speed. The results showed that when the vaginal speculum was placed 2 minutes after administration (T_1), the MAP, RR and SpO₂ of patients in both groups decreased compared with T_0 . However, the fluctuations of MAP, RR and SpO₂ in Group C were smaller, and the incidences of respiratory depression, hypoxemia and hypotension were significantly lower than those in Group P. It indicates that both drugs have a certain degree of circulatory and respiratory inhibitory effects, but the inhibitory effect of ciprofol on circulation and respiration is relatively mild, and the difference is statistically significant. Previous studies have shown that when using propofol for sedation, it has a dose-dependent inhibitory effect on the patient's respiratory and circulatory systems, which is often manifested as the higher the infusion dose, the more obvious the adverse reactions such as apnea and blood pressure drop during the operation [18]. In recent years, many studies on ciprofol [19]-[21] have shown that the probabilities of hypotension, respiratory depression and hypoxemia in patients using ciprofol are lower than those in patients using propofol. It is speculated that this may be because the affinity of ciprofol with the GABAA receptor is stronger, its potency is about 4 to 5 times that of propofol. At the same time, when the same anesthesia depth is reached, the plasma drug concentration of ciprofol is lower, thereby weakening the inhibitory effects on myocardial contraction, vascular tension and respiration. In addition, after ciprofol is metabolized in the human body, its main circulating metabolite M4 in plasma is usually inactive and has no toxicity and sedative-hypnotic effect [5]. The results of Bian *et al.* [22] on the pharmacokinetics and pharmacodynamics of ciprofol show that almost no residual effect exists after all subjects wake up smoothly in a short time, thereby showing higher safety.

In terms of comfort, propofol shows a series of advantages such as a lower incidence of postoperative dizziness, nausea, vomiting, and no hangover feeling. The results of this study also showed that there was no statistical difference in nausea and vomiting, dizziness and VAS pain score 30 minutes after the operation between the two groups, which fully indicates that the two have the same effect in these aspects. However, it is worth noting that injection pain of propofol is an extremely common problem in clinical anesthesia. Due to its strong irritation to blood vessels, the incidence of injection pain can be as high as 94% [4], causing patients to have tension, anxiety, fear and intraoperative body movement during anesthesia induction [23], which has a certain impact on its comfort. In contrast, many literatures report that the incidence of injection pain of ciprofol is low, making its advantage prominent. In this study, the incidence of injection pain induced by ciprofol combined with fentanyl was only

8.6%. Compared with 65.7% of propofol combined with fentanyl, the incidence of injection pain was significantly reduced, which was similar to the research results of Yi Qianglin *et al.* [24]. Teng *et al.* [25] believed that the different incidences of injection pain of the two drugs were due to the different concentrations of the drugs in the aqueous phase of the injection solution. The study of Jalota *et al.* [26] has shown that the higher the concentration of free propofol, the more obvious the pain during injection. The research results of Hao Yingchun [14] also showed that the pain degree at the injection site related to cyclopropanol was relatively mild, which may be related to the low oil content and poor water solubility after the introduction of the cyclopropyl group in the molecular structure of cyclopropanol [16]. At the same time, cyclopropanol has stronger hydrophobicity and lower plasma concentration [17], which also indicates that it may be related to the lower incidence of injection pain. In addition, in terms of satisfaction with anesthesia, patients were more satisfied with the ciprofol group, and the difference was statistically significant. The reason for this may be related to the injection pain caused during anesthesia induction. The satisfaction situation is consistent with the research results of Hu Zefan *et al.* [2], indicating that the application of ciprofol in patients with painless induced abortion has higher comfort and improves patient satisfaction.

Compound ciprofol and fentanyl can not only be used for painless induced abortion but also for other short-term examinations or surgeries. Zhong [27] *et al.* compared the application of ciprofol and propofol in non-operating room settings such as endoscopic submucosal dissection, endoscopic retrograde cholangiopancreatography, and flexible bronchoscopy. The results showed that except for the prolonged induction time of flexible bronchoscopy patients, the sedation or anesthesia level induced by ciprofol was equivalent to that induced by propofol. Another study showed that in the process of colonoscopy, the sedative/anesthetic effect induced by 0.4 - 0.5 mg/kg ciprofol was equivalent to 2.0 mg/kg propofol, with similar safety characteristics and no serious adverse events occurred [25].

This study also has certain limitations. First of all, the sample size of this study is small and it is a single-center clinical study. More large-sample multi-center clinical research data are needed for confirmation, as well as in-depth discussions on the differences in other rare adverse reactions such as sexual fantasies, dreams, and epileptiform activities; secondly, the potency of ciprofol and propofol in this study was compared at 1:4, and the anesthesia effect, effectiveness and safety issues at different potencies were not discussed. Whether 0.5 mg/kg of ciprofol is the optimal anesthesia dose for painless induced abortion still needs to be determined through further comparative studies in the future. Finally, the subjects of this study only included patients with ASA grade I or II. For special patients with longer operation time, complex operation methods, and combined cardiopulmonary and renal insufficiency, whether there are differences in the effects of ciprofol and propofol on circulation and respiration still needs further research.

In conclusion, compared with 2 mg/kg of propofol, 0.5 mg/kg of ciprofol combined with 1.5 ug/kg of fentanyl for sedation and analgesia in painless induced abortion has a definite effect, a more stable respiratory and circulatory system, fewer adverse reactions, higher safety and comfort, and therefore is worthy of clinical promotion and application.

Conflicts of Interest

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

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