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Original Article

Comparison of sedative effects between dexmedetomidine and propofol in painless artificial abortion

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Abstract: Objective: The aim of this study was to compare the sedative effects of dexmedetomidine and propofol in painless artificial abortion patients, discuss the safety and comfort of the anesthesia method, and to provide relevant evidence for clinical anesthesia of painless abortion. Methods: Using the random number table method, this study selected 200 patients that underwent abortions in the Department of Anesthesiology of Jinhua Municipal Central Hospital, from January 2015 to December 2017. American Society of Anesthesiologists (ASA) grades I to II were included, ages 18 to 40. A hundred cases of dexmedetomidine injections were used for induction and maintenance of anesthesia (Group D). A hundred cases of propofol injections were used for induction and maintenance of anesthesia (Group P). Heart rate (HR), mean arterial pressure (MAP), oxygen saturation (SpO_2), modified observer's assessment of alertness/sedation scale (MOAA/S), and incidence of respiratory depression, hypotension, sinus bradycardia, and other complications during surgery were compared between the two groups in T_0 (before anesthesia), T_1 (2 minutes after medication), T_2 (uterus dilatation), and T_3 (5 minutes after surgery), respectively. Results: There were no significant differences in MAP, HR, SpO_2, and MOAA/S scores between group D and group P at the time of T_0 ($P>0.05$). In group D, MAP and HR were lower than those in group P during T_1-T_3, but SpO_2 was significantly higher than that in group P (all $P<0.0001$). MOAA/S scores in group D were significantly lower than those in group P during T_1-T_3 (all $P<0.0001$). However, incidence of respiratory depression in group P was significantly higher than that of group D. Incidence of intraoperative hypotension and sinus bradycardia in group D were significantly higher than that of group P (all $P<0.0001$). Conclusion: In painless artificial abortions, the sedative effects of dexmedetomidine are significantly better than propofol and there is no respiratory depression. The hemodynamics of propofol are relatively more stable.

Keywords: Dexmedetomidine, propofol, sedation, hemodynamics, respiratory depression

Introduction

Artificial abortion is a common surgery in gynecology. According to statistics, the number of artificial abortions in China is about 10 million per year [1]. As this affects the reproductive health of women, artificial abortions have become a national medical concern [2]. To make patients painless, safe, and comfortable during surgery and to reduce intraoperative and postoperative complications, seeking more ideal methods of anesthesia is essential for clinical anesthesia.

Artificial abortions are generally completed within 10 to 20 minutes. There is little trauma to the patient but they require high quality anesthesia for pain, safety, comfort, and efficiency. Although the operation time is short, hypotension, decrease of heart rate or even cardiac arrest, intraoperative awareness caused by ineffective analgesia during the operation, and other abnormal phenomena can be life-threatening for patients. Therefore, seeking an anesthesia method with less pain, better sedation, and less adverse reactions after surgery is critical for clinical anesthesia [3, 4].

Painless artificial abortion is a painless surgery with intravenous general anesthesia and suction abortion. There is no pain during the procedure [5]. The most common intravenous anes-

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

	Group D	Group P	X^2/t value	*P* value
Number of cases	100	100		
ASA I	45	50	0.5010	0.4790
ASA II	55	50		
Age	25.2 ± 5.8	28.6 ± 4.7	1.8750	0.0622
Weight (kg)	55.4 ± 7.8	56.3 ± 4.8	1.1160	0.2656
Duration of Pregnancy (d)	54.0 ± 4.8	55.0 ± 5.2	1.4130	0.1592
Operation time (min)	8.2 ± 2.1	7.9 ± 2.6	0.8976	0.3705

Note: Group D: dexmedetomidine group; group P: propofol group; ASA, American Society of Anesthesiologists.

Table 2. Comparison of MAP, HR, and SpO_2 values at different time points in the two groups of patients

		Group D	Group P	T value	*P* value
MAP (mmHg)	T_0	123.8 ± 10.3	122.5 ± 9.8	0.9144	0.3616
	T_1	85.3 ± 4.5	103.6 ± 5.2	36.7905	<0.0001
	T_2	92.4 ± 3.5	105.3 ± 2.6	29.5868	<0.0001
	T_3	100.4 ± 4.5	115.5 ± 2.9	28.2058	<0.0001
HR (cpm)	T_0	70.4 ± 5.6	71.5 ± 3.2	1.7055	0.0897
	T_1	56.2 ± 3.2	65.2 ± 2.3	22.8379	<0.0001
	T_2	61.5 ± 3.2	68.3 ± 2.6	16.4924	<0.0001
	T_3	60.3 ± 2.7	70.3 ± 2.8	25.7087	<0.0001
SpO_2 (%)	T_0	99.3 ± 0.7	99.4 ± 0.6	1.0846	0.2794
	T_1	99.5 ± 0.5	90.4 ± 0.5	128.6930	<0.0001
	T_2	99.0 ± 0.2	89.4 ± 0.4	214.6620	<0.0001
	T_3	98.3 ± 1.2	92.7 ± 0.5	43.0770	<0.0001

Note: Group D: dexmedetomidine group; group P: propofol group; T_0: before anesthesia; T_1: 2 min after medication; T_2: uterus dilatation; T_3: 5 min after surgery; HR: heart rate; MAP: mean arterial pressure; SpO_2: oxygen saturation.

thetic used in painless abortion is propofol. Although it has the advantages of rapid onset, short duration of action, and quick recovery, it has weak analgesic effects that could cause body movement during surgery [6]. Dexmedetomidine is an α2 adrenoceptor-agonist that blocks sympathetic nerves and has strong effects of sedation and hypnosis. It has been widely used in the field of anesthesia [7]. Ishibashi et al. found that during continuous epidural anesthesia of percutaneous nephrolithotomy lithotripsy, dexmedetomidine had obvious characteristics of conscious sedation with less irritability and body movement. Maintenance of intraoperative hemodynamic stability makes the surgery more successful [8].

Dexmedetomidine has rarely been reported in the sedation application of painless artificial abortion. Therefore, this study compared sedation and hemodynamic effects of propofol and dexmedetomidine in human abortions to provide a basis for clinical anesthesia.

Materials and methods

General information

Using the random number table method, this study selected 200 patients with artificial abortions, from January 2015 to December 2017, in the Department of Anesthesiology of Jinhua Municipal Central Hospital, ASA I-II grade. All patients signed informed consent and the study was approved by the Ethics Committee of Jinhua Municipal of Central Hospital.

Inclusion criteria

Preoperative diagnosis was intrauterine pregnancy. Pregnancy time 30-60 days (gestational sac ≤20 mm). Age was 18 to 40 years old, with no vaginal birth history, and it was the first painless artificial abortion.

Exclusion criteria

Abnormal cardiopulmonary function, abnormal liver and kidney function, mental disorders, and operation times were significantly longer than 20 minutes or significant bleeding during surgery.

Grouping method

Dexmedetomidine group (group D): 100 cases of dexmedetomidine injections for induction and maintenance of anesthesia. Dexmedetomidine hydrochloride injections purchased from Jiangsu Hengrui Medicine Co, Ltd.

Propofol group (P group): 100 cases of propofol injections were used for induction and maintenance of anesthesia. Propofol medium/long-chain fat emulsion injections purchased from Beijing Fresenius Kabi Pharmaceutical Co, Ltd.

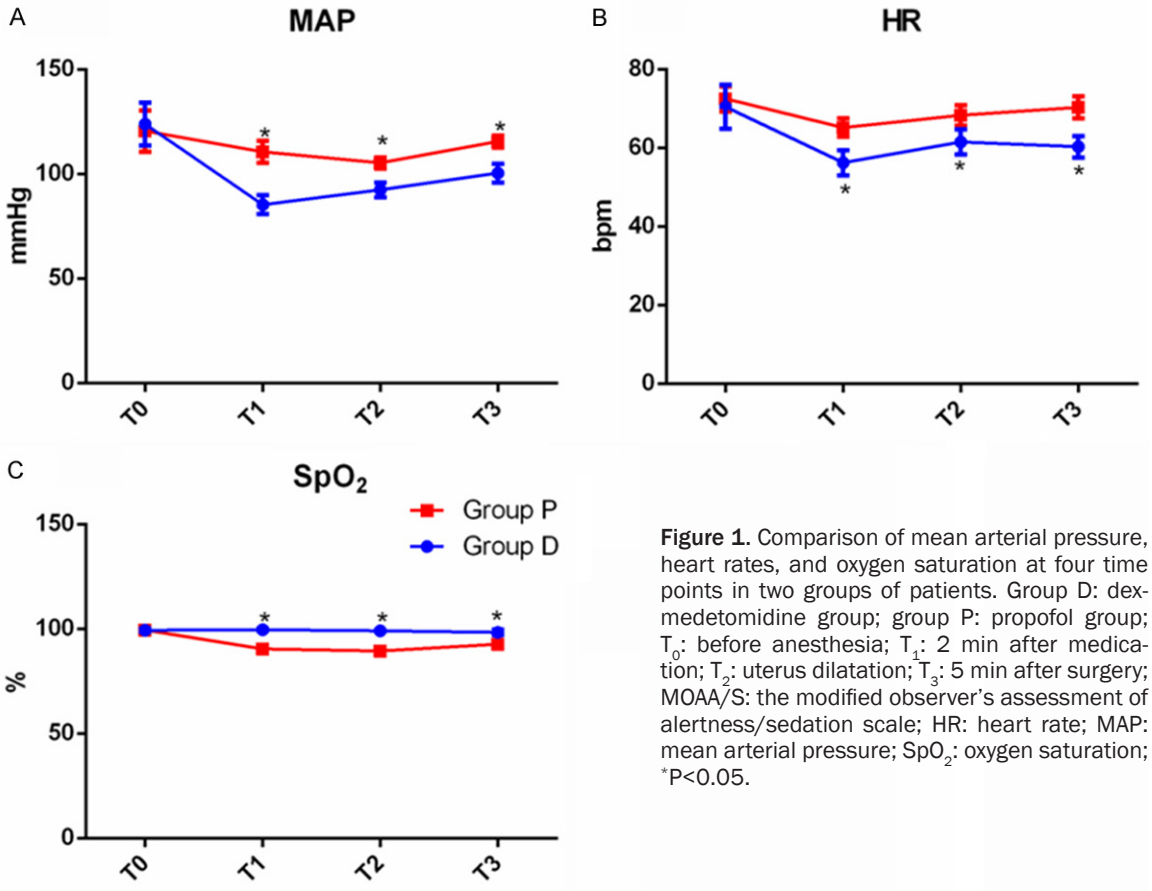

Figure 1. Comparison of mean arterial pressure, heart rates, and oxygen saturation at four time points in two groups of patients. Group D: dexmedetomidine group; group P: propofol group; T_0: before anesthesia; T_1: 2 min after medication; T_2: uterus dilatation; T_3: 5 min after surgery; MOAA/S: the modified observer's assessment of alertness/sedation scale; HR: heart rate; MAP: mean arterial pressure; SpO_2: oxygen saturation; *P<0.05.

Anesthesia method

Abrosia for 8 hours and water-deprivation for 4 hours before anesthesia were routine for all patients. After admission to the operation room, the venous access of patients was opened. Lactated Ringer's solution was maintained intravenously and titrated slowly. They connected the right upper cuff to monitor blood pressure, monitored heart rate by electrocardiogram, monitored oxygen saturation by pulse oximetry, and maintained airway patency and oxygen with a mask by oxygen flow rate 3.0 L/min. After lithotomy positioning, skin preparation, and draping, patients in group D were given a slow injection of dexmedetomidine by 1.0 μg/kg, gradually entering a sleep state. When the eyelash reflex and response of call disappeared, the abortion was performed. They transfused continuous intravenous infusion to patients at a speed of 0.7 μg/kg/h until the end of surgery. In group P, propofol was induced intravenously at a dose of 0.6 mg/kg, followed by an intravenous infusion to patients at a speed of 3.0 μg/kg/h until the end of the surgery. If patients had physical movement or moaning during surgery, propofol or dexmedetomidine was added until patients became calm.

Observation indicators

General condition of patients: Patient preoperative age, weight, gestational age, and operation times were observed and recorded.

Observation time points: Time points included T_0 (before anesthesia), T_1 (2 minutes after medication), T_2 (uterus dilatation), and T_3 (5 minutes after surgery).

Main indicators: Hemodynamics: Recorded heart rate, mean arterial pressure, and oxygen saturation at all four time points.

MOAA/S scores: 5 points, completely awake, normal response to normal call; 4 points, responded slowly to normal call; 3 points, no response to normal call, responded to repeated loud calls; 2 points, no response to repeated loud calls, response to a pat on the body; 1 point, no response to a pat on the body, but responded to noxious stimulation; 0 points, no response to noxious stimulation.

Table 3. Comparison of improved MOAA/S scores at different time points in the two groups of patients

	Group D	Group P	T value	*P* value
T_0	5.00	5.00		
T_1	0.50 ± 0.04	2.30 ± 0.05	281.1000	<0.0001
T_2	0.10 ± 0.03	1.20 ± 0.04	220.0000	<0.0001
T_3	3.50 ± 0.08	4.70 ± 0.10	93.7000	<0.0001

Note: Group D: dexmedetomidine group; group P: propofol group; T_0: before anesthesia; T_1: 2 min after medication; T_2: uterus dilatation; T_3: 5 min after surgery; MOAA/S: the modified observer's assessment of alertness/sedation scale.

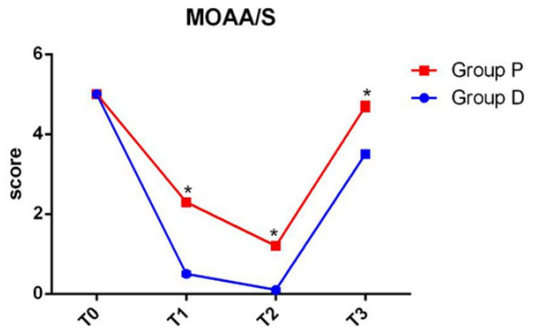

Figure 2. Comparison of MOAA/S sedation scores in the two groups of patients. Group D: dexmedetomidine group; group P: propofol group; T_0: before anesthesia; T_1: 2 min after medication; T_2: uterus dilatation; T_3: 5 min after surgery; MOAA/S: the modified observer's assessment of alertness/sedation scale; *P<0.05.

Secondary observation indicators: Adverse reactions: Hypotension, sinus bradycardia, and respiratory depression during the operation were observed and recorded.

Hypotension: systolic blood pressure <90 mmHg or less than 30% of basal blood pressure.

Sinus bradycardia: heart rate <60 beats/min, less than 30% of the basal heart rate.

Respiratory inhibition: Respiratory frequency <8 times/min, oxygen saturation <90%. If respiratory inhibition occurred during the operation, the mask was immediately applied with a pressurized oxygen supply.

Statistical analysis

All data were statistically analyzed using SPSS17.0 software. Graph Pad Prism 5 was used for picture drawing. Measured data are expressed as mean ± sd. Differences between the 2 groups in baseline measurements were compared using a two-sample independent t-test. Comparison of count data used a double-side Chi-square test (X^2) or Fisher's Exact Test. Significance level is defined as α=0.05 and there are statistically significant differences when P<0.05.

Results

Analysis of general information

There were no significant differences between group D and group P in age, ASA grade, and operation time of patients (P>0.05) a shown in **Table 1**.

Hemodynamic comparison between the two groups at four time points

At T_0 (before anesthesia), there were no significant differences in mean arterial pressure, heart rate, and oxygen saturation between the two groups (P>0.05) as shown in **Table 2** and **Figure 1**.

At T_1 (2 minutes after medication), T_2 (uterus dilatation), and T_3 (5 minutes after surgery), mean arterial pressure and heart rates in group D were significantly lower than those in group P. Oxygen saturation was significantly decreased in group P, while there was no significant change in group D. Differences between the two groups at T_1, T_2 and T_3 were statistically significant (all P<0.0001) as shown in **Table 2** and **Figure 1**.

Comparison of MOAA/S scores in the two groups of patients

MOAA/S scores in group D at T_1-T_3 were lower than those in group P and differences were statistically significant (P<0.0001) as shown in **Table 3** and **Figure 2**.

Comparison of intraoperative complications between the two groups

The number of patients with respiratory inhibition in group P was significantly higher than in group D (P<0.0001). Patients with intraoperative hypotension and sinus bradycardia in group D were significantly more than those in group P (both P<0.0001) as shown in **Table 4**.

Discussion

Painless artificial abortion is a new, safe, and effective intravenous general anesthetic. Pre-

Table 4. Comparison of intraoperative complications between the two groups

	Group D	Group P	X^2 value	*P* value
Hypotension	36	5	29.4830	<0.0001
Sinus bradycardia	48	10	35.0660	<0.0001
Respiratory inhibition	8	38	25.4090	<0.0001

Note: Group D: dexmedetomidine group; group P: propofol group.

gnant women can enter a sleep state within 30 seconds and surgeons can complete the operation in a short time. Although the operation is short and quick, uterus dilatation operations could bring great physical and mental harm to patients [9]. Intravenous sedative drug infusions during the operation can eliminate patient tension and anxiety, enable hemodynamic stability, and reduce the effects of postoperative complications. Many studies have shown that the use of dexmedetomidine and propofol can maintain a safe and effective conduct of artificial abortions [10, 11].

Some studies have found that dexmedetomidine has significant effects on the cardiovascular syste. In the early stage of injection of dexmedetomidine, a transient two-phase cardiovascular reaction appears on the body, a dose-dependent reaction. It has been reported in the literature that a dose of 1 μg/kg dexmedetomidine could cause transient elevation of blood pressure and reflex heart rate reduction. These were more common in young patients or healthy volunteers [12]. This may be due to a direct reduction of peripheral resistance, inhibition of the extraction of calcium ions by the endoplasmic reticulum, inhibition of myocardial contractility, inhibition of the reaction of cyclic baroreceptors to hypotension, inhibition of vasomotor centers, and release of norepinephrine from sympathetic nerve endings. Through the mechanisms above, blood pressure drops and heart rates slow down during intravenous injections of dexmedetomidine [13, 14]. This present study found that intraoperative and postoperative hemodynamics in the propofol group were more stable than the dexmedetomidine group, consistent with previous results.

The present study found that the sedative effects of dexmedetomidine were superior to propofol during induction and maintenance of anesthesia and the postoperative period. Dexmedetomidine is a highly effective α2 adrenergic receptor agonist. Its main mechanism is to regulate arousal and sleep by acting on the A2AR in the pons and the locus coeruleus of medulla. Locus ceruleus (LC) located in brainstem is a brain nucleus rich in adrenergic receptors that plays a major role in regulating arousal [15, 16]. Dexmedetomidine binds to the α2-adrenoceptor on the cell membrane of norepinephrine-producing neurons on LC, inhibits the activity of AC, decreases the content of cAMP in cells, accelerates intracellular anabolic process, and produces sedative and hypnosis effects [17]. Animal experiments have found that sedating doses of dexmedetomidine can inhibit the release of NE from LC [11]. The ventrolateral preoptic nucleus (VLPO) loses its control of NE and releases Y-aminobutyric acid (GABA) and galanin. These two neurotransmitters also inhibit LC and the tuberomammillary nucleus (TMN) in medial thalamus, causing a decrease in TMN histamine release and producing a hypnotic effect [18]. The acting site of dexmedetomidine analgesia is also regarded to be in the spinal dorsal horn [19]. Propofol acts on the central GABA to produce a certain sedative effect, with rapid onset, short duration of action, no accumulation, and rapid recovery [20, 21]. However, propofol has poor analgesia, large intravenous stimulation, and a high dose requirement. Rapid injections or large doses may cause adverse reactions such as respiratory and blood circulation inhibition. Moreover, changes in mean arterial pressure and heart rates during induction, unavoidable intraoperative limb movement, and low levels of sedation are notable defects of propofol.

Some studies have found that dexmedetomidine can produce deeper sedation with less effects on respiration, even at 15 times the therapeutic dose of plasma concentrations [22]. The possible mechanism is that dexmedetomidine retains the body's awakening to hypercapnia, but the threshold of suffocation is reduced [23, 24]. Therefore, compared with an injection of propofol, dexmedetomidine can be safely used for extraction of endotracheal tubes. Although there is no respiratory inhibition, dexmedetomidine was initially approved by the FDA only for patients with initial intubation mechanical ventilation. By October 2008, the FDA approved sedation for non-intubated

patients [25]. This study found that incidence of respiratory inhibition in the propofol group was significantly higher than that of the dexmedetomidine group.

There were some limitations to the present study. Sedative effects and hemodynamics of dexmedetomidine and propofol on painless artificial abortion were compared, but no further study was made regarding underlying mechanisms. The next study will examine, in depth, how dexmedetomidine and propofol can improve the mechanism of intraoperative and postoperative sedation and circulation by regulating the nervous system and circulatory system.

In conclusion, in gynecological painless artificial abortion surgeries, the sedative effects of dexmedetomidine are significantly better than propofol. There is no respiratory inhibition with dexmedetomidine, whereas the hemodynamics of propofol are relatively more stable.

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Disclosure of conflict of interest

None.

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