Review Article
Effects of fentanyl and butorphanol on uterine contraction pain after induced abortion: a randomized controlled clinical trial

Changting Yan[1], Na Ding[2], Yunhua Wei[1], Zhen Yuan[1], Yuhua Li[1], Yu Cao[3], Qun Wang[1], Xueya Yao[4], Peng Huang[5]

[1]Department of Anesthesiology, Liaocheng Dongchangfu District Maternal and Child Health Hospital, Liaocheng, Shandong Province, China; [2]Department of Anesthesiology, Taian Rongjun Hospital, Taian, Shandong Province, China; [3]Department of Urinary Surgery, Ningxiang Hospital Affiliated to Hu'nan University of Chinese Medicine, Changsha, Hu'nan Province, China; [4]Department of Anesthesiology, Renji Hospital, School of Medicine, Shanghai Jiao Tong University, Shanghai City, China; [5]Department of Gynaecology and Obstetrics, Maternity and Child Health Care Hospital of Huanggang City, Huanggang 438000, Hubei Province, China

Abstract: Objective: Surgical induced abortion is a common remedy for contraceptive failure, usually processed under intravenous anesthesia in a clinic. Uterine contraction pain often occurs after the operation, affecting recovery or inducing more severe complications in women. Methods: To relieve this kind of pain, this study performed a randomized controlled trial using common analgesics, including fentanyl and butorphanol, from January to December in 2016. Ninety-nine patients meeting the inclusion criteria were included in the study and randomly divided into three groups: propofol group, fentanyl group, and butorphanol group. In the propofol group, patients were anesthetized with a single use of propofol. In the fentanyl group and butorphanol group, a combination of fentanyl and propofol was administered. Basic information, evaluation of anesthesia effects, changes of vital signs, incidence of complications, and Visual Analogue Scale (VAS) scores for uterine contraction pain were collected and analyzed. Results: Butorphanol and fentanyl groups demonstrated superior anesthetic effects over the propofol group (P<0.001), but no significant differences were found between the former two groups (P=0.064). Butorphanol group consumed the least propofol, compared to the other two groups (115.91 ± 21.70 mg, P<0.01), and recovery time (14.00 ± 1.35 min) was a bit longer than the fentanyl group (P=0.0015) and propofol group (12.61 ± 1.91, P=0.2416), although the latter difference was not significant. Hypotension in the fentanyl group was obvious and incidence (48.5%) was higher than in propofol (P=0.009) and butorphanol groups (30.3%, P=0.131). Incidence of dizziness was also higher in fentanyl group, compared with the other two groups (P=0.007), while drowsiness occurred most frequently in the butorphanol group (P=0.000). Changes in vital signs were maximal in fentanyl group and minimal in the propofol group. Uterine contraction pain after surgery was most severe in propofol group (P=0.003) and slightest in the butorphanol group (P<0.01) when discharged. Conclusion: This present study provides evidence for selecting proper analgesics in induced abortion. Butorphanol is more suitable for stabilizing vital signs and preventing uterine contraction pain than fentanyl, during and after the operation.

Keywords: Fentanyl, butorphanol, induced abortion, uterine contraction pain

Introduction

Induced abortion is a very common minor operation acting as a supplemental method for accidental pregnancy. From 2010 to 2014, 56,300,000 cases of induced abortion per year were conducted worldwide [1]. In China, data published by The National Health and Family Planning Commission in 2013 indicated that incidence of induced abortion was 30.7% per year during 2012 [2]. Induced abortion can result in many complications such as perforation, infections, bleeding, and uterine contraction pain, which may present as abdominal pain [3]. It has been reported that incidence of uterine contraction pain after induced abortion is nearly 56.7%. This discomfort has seriously affected patient wellbeing after surgery [4].
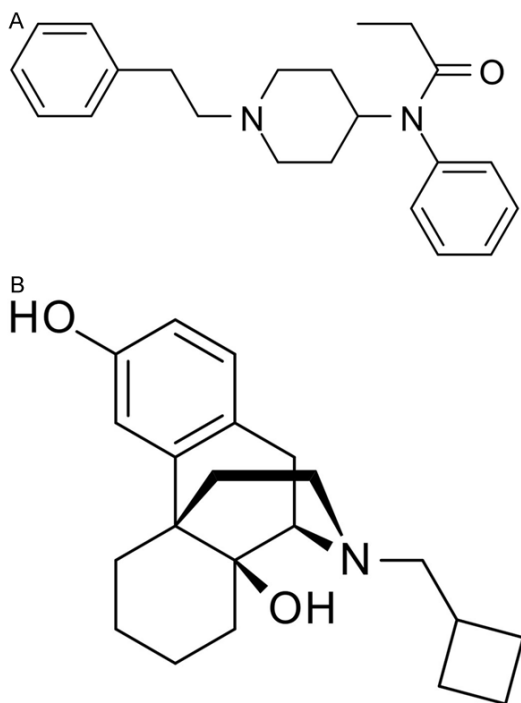
Figure 1. Molecular formulas of fentanyl (A) and butorphanol (B).

Generally, this kind of pain could gradually disappear in two to three days after surgery, but severe pain or acute pain might induce abnormal autonomic nervous activity, appearing as sweating, nausea, vomiting, and even changing of vital signs [5]. This pain might develop into anxiety and depression in some women [6]. Normal analgesics such as paracetamol and aspirin have had little effect on this visceral pain.

Based on many abortion cases and high incidence of uterine contraction pain, many studies have explored different methods including analgesics, such as opioids [7, 8], non-steroidal anti-inflammation drugs (NSAIDs) [9], nerve blocking, general anesthesia [10], moxibustion [11], transcutaneous electrical nerve stimulation [12], and so forth to manage pain after surgery. However, single treatments seem to be insufficient for pain relief [13, 14]. In addition, patients undergoing general anesthesia generally achieve excellent pain control during the operation but more severe pain post-operation. Blood loss can increase when inhalation anesthetics are used [14].

At present, surgery-induced abortion is performed mainly under intravenous anesthesia,

in China, to avoid pain perception and unpleasant experiences. To alleviate obvious uterine contraction pain, after the operation and anesthesia, many researchers have conducted lots of methods to prevent or treat this kind of pain. A definite conclusion, however, has been elusive and further studies are necessary.

Fentanyl is the most commonly used narcotic analgesic in clinical practice. It is a μ-opioid receptor agonist. Its analgesic intensity is about 50~100 times more than morphine and has little influence on the cardiovascular system. When administered intravenously, it takes effect within one minute, peaks at the fourth minute, and maintains for 30 minutes [15]. Because of the good analgesic effects and rapid metabolism, it is very suitable for outpatient and minor surgeries such as surgical induced abortion. Butorphanol is a synthetic opioid receptor agonist-antagonist that partially agitates and antagonizes the μ-receptor and partially agitates κ-receptor, with an analgesic intensity about 4~5 times more than that of morphine. It exhibits quick onset and elimination half-life is about 4~6 hours [15]. Its use in post-operative analgesia has been widely studied [16, 17]. Clinical results have shown desirable effects. Molecular formulas of the two drugs are shown in **Figure 1**.

Hence, in this study, a randomized controlled trial was designed to further explore potential treatments for uterine contraction pain after induced abortion, using these two common opioids. The primary aim of this study was to compare preventive and therapeutic effects of the two drugs on this kind of pain. The secondary aim was to explore effectiveness, safety, and patient satisfaction during and after surgery.

Methods

This work was approved by the Ethical Committee of Liaocheng Dongchangfu District Maternal and Child Health Hospital.

Subjects

Women coming to Liaocheng Dongchangfu District Maternal and Child Health Hospital for induced abortion, from January to October in 2016, were included in this clinical trial. Inclusion and exclusion criteria were established to screen suitable subjects. Inclusion criteria included: ASA I-II; 18-35 years old; Early preg-

Table 1. Basic information of all included patients

	Propofol	Fentanyl	Butorphanol	P value
Age (year)	28.12 ± 3.96	28.76 ± 4.83	26.88 ± 3.72	0.1859
Weight (kg)	56.89 ± 6.18	58.45 ± 8.66	56.29 ± 7.95	0.5006
Gestational days (day)	50.52 ± 11.38	51.09 ± 10.05	49.55 ± 8.42	0.8188

Note: All data are presented as mean ± SD, n=33 per group. ANOVA followed by Tukey's multiple comparison test.

Table 2. Evaluation of anesthetic effects among three groups

Rating \ Groups	Propofol	Fentanyl	Butorphanol
Excellent	13 (39.4%)	25 (75.8%)	33 (100.0%)
Good	11 (33.3%)	6 (18.2%)	2 (6.1%)
Poor	9 (27.3%)	2 (6.1%)	0 (0.0%)
P value		<0.0001**	<0.0001**

Note: All data are presented as n (%), n=33 per group. **, vs. propofol; fentanyl vs. butorphanol, P=0.064. Kruskal-Wallis H test followed by Ridit analysis.

nancy suitable for induced abortion. Exclusion criteria included: Abnormal pregnancy; Overweight with weight ≥75 kg; Scarred uterus; Complicated with other diseases; Having caught a cold in the past two weeks; Abortion was performed more than three times; Refused to sign informed consent.

As previously stated, all participants were randomly divided into three groups: propofol group, fentanyl group, and butorphanol group. They were taught to use the Visual Analogue Scale (VAS) to assess pain and were reminded of possible testing after surgery.

To determine the sample size of this study, preliminary experiments were conducted to obtain significant differences of VAS scores and the standard deviation (SD). Power and Sample Size Calculation Program (version 3.1.2) was then used to calculate sample size and the total number of one group was thirty [18]. Considering the off-group situation, this number was increased by 10%. Eventually, the sample size of each group was determined to be 33.

Randomization and allocation

Patients were numbered from one to ninety-nine according to the sequence in which they came to Liaocheng Dongchangfu District Maternal and Child Health Hospital. Random number table was used to generate the ran-

domized group for each participant. All information was then enclosed by a sealed opaque envelope with continuous numbers. They were opened by one of the current authors (Yuan), only if patients had entered the operation room. The author, with decades of experience in anesthesia, was responsible for clinical anesthesia. Randomization and sealed envelopes were prepared by another author (Yao).

Intervention

All groups received the same preparation before surgery. This included fasting, no preoperative medication, basic vital sign monitoring, and intravenous infusion of 0.9% saline at the speed of 8 mL/kg·h through the upper limb. Once entering the operation room, oxygen inhalation was performed through a nasal catheter and oxygen flow rate was 2 L/min.

In the propofol group, 2 mL 0.9% saline was intravenously infused. Two minutes later, propofol was intravenously administrated with a single dose of 2 mg/kg. If necessary, 0.5 mg/kg propofol would be additionally injected.

In the fentanyl and butorphanol groups, single doses of 1 µg/kg of fentanyl and 10 µg/kg of butorphanol were intravenously injected, respectively. Other interventions after this single administration were identical to the propofol group.

To protect against decrease of heart rate and blood pressure caused by general anesthesia, surgical distraction, and possible artificial abortion syndrome, atropine and ephedrine were injected with single doses of 0.5 mg and 15 mg, respectively, if heart rate or systolic pressure were lower than 60 beats/min or 80 mmHg.

Oxygen was be supplied by a mask to assist breathing if respiratory depression appeared or if oxygen saturation (SpO_2) was lower than 90%.

Data acquisition

Pre-operation: Basic information including age, weight, and days of pregnancy were collected from included patients before the operation.

Table 3. Anesthetic effects and consumption of propofol among three groups

	Propofol	Fentanyl	Butorphanol	P value
Onset time (min)	1.04 ± 0.10	0.99 ± 0.15	1.04 ± 0.15	0.2096
Recovery time (min)	12.61 ± 1.91	10.91 ± 1.17	14.00 ± 1.35[##]	0.0023
Operation time (min)	3.55 ± 0.94	3.24 ± 0.79	3.21 ± 0.93	0.2466
Propofol dosage (mg)	156.52 ± 36.07	136.52 ± 19.55[*]	115.91 ± 21.70[**,##]	<0.0001

Note: All data are presented as mean ± SD, n=33 per group. For recovery time, ##, *vs.* Fentanyl, P=0.0015. For propofol dosage, *, *vs.* propofol, P=0.0103; **, P<0.0001; ##, *vs.* fentanyl, P=0.0001. ANOVA followed by Tukey's multiple comparison test.
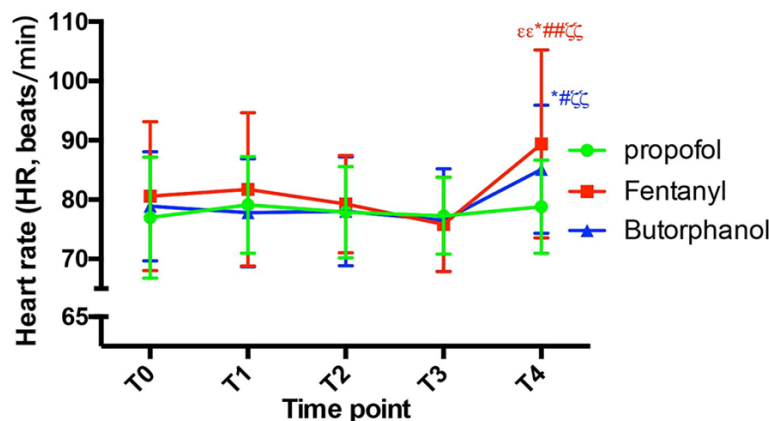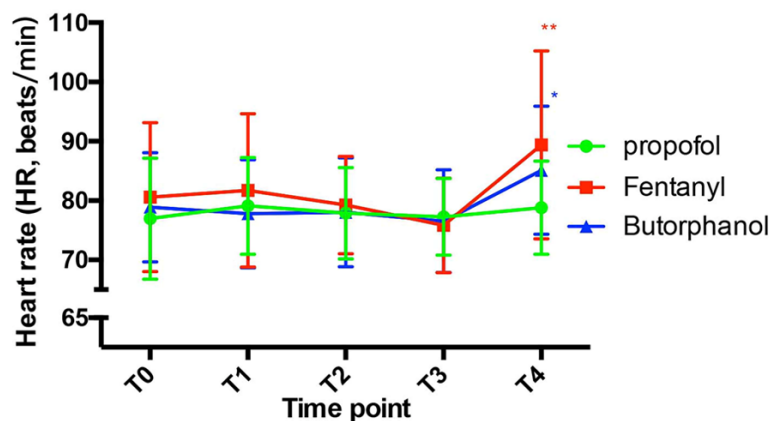

Figure 2. Heart rate (HR) trend over time and changes of HR among three groups n=33 per group. A. Comparison of HR at different time points in one single group. εε, *vs.* T0, P<0.01; *, *vs.* T1, P<0.05; **, *vs.* T1, P<0.01; #, *vs.* T2, P<0.05; ##, *vs.* T2, P<0.01; ζ, *vs.* T3, P<0.05. B. Comparison of HR among three groups at the same time point. *, *vs.* propofol, P<0.05; **, *vs.* propofol, P<0.01. Two-way ANOVA followed by Tukey's multiple comparison test.

tion, T1 for disappearance of eyelash reflex, T2 for the beginning of surgery, T3 for intrauterine vacuum suction, and T4 referred to the recovery time point. On the basis of collected data of MAP, incidence of hypotension, defined as MAP <80%-70%, and baseline were calculated [19].

Onset time, recovery time of anesthesia, and operation time, partly representing the anesthetic effect, were collected. Onset time was defined as the time from first administration to the disappearance of eyelash reflex; Recovery time was the time from eyelash reflex disappearance to the time when patients could open their eyes (awakening); Operation time referred to time from the beginning to the end of surgery.

Intraoperative complications including respiration depression, shivering, and others occurring during the operation were described and noted. At the end of surgery, total consumption of propofol was also recorded.

Evaluation of anesthetic effects was categorized into three grades: excellent, good, and poor, according to the following criteria: (1) Excellent: quiet sleep, no intraoperative body activities with cervical relaxation; (2) Good: sleeping, slight intraoperative physical activities without disturbing the surgery, acceptable
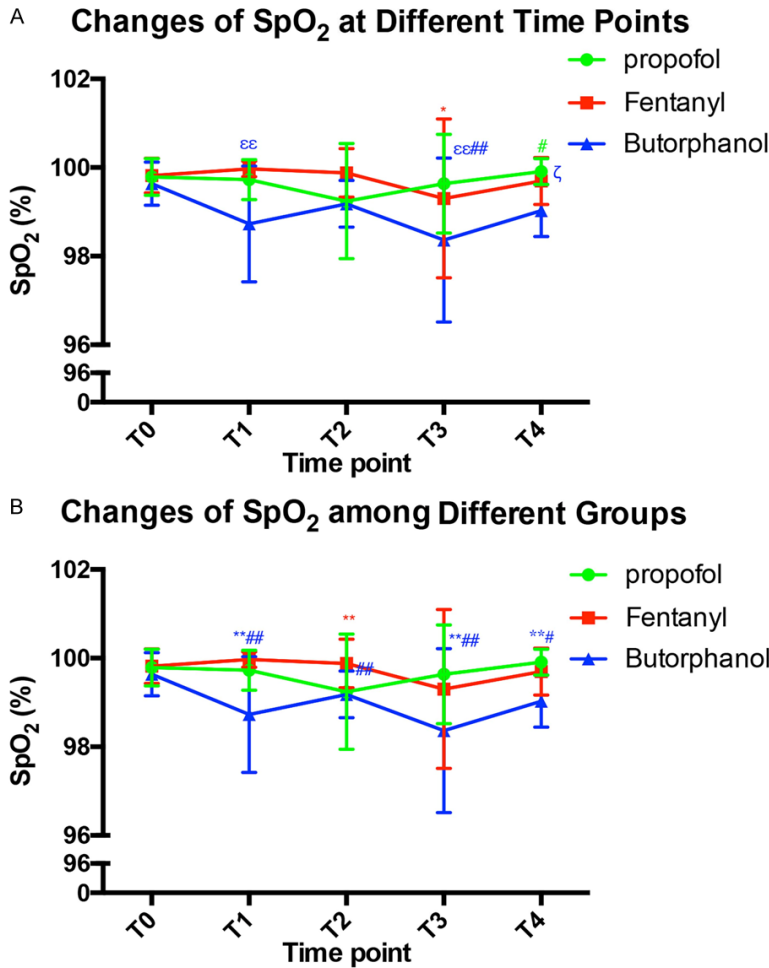
During operation: Once anesthesia began, patient heart rate (HR), SpO$_2$, and mean arterial pressure (MAP) were monitored at five different time points (T0~T4) and recorded successively; T0 for anesthetics or placebo injec-

A Changes of SpO$_2$ at Different Time Points

B Changes of SpO$_2$ among Different Groups

Figure 3. SpO$_2$ trend over time and changes of SpO$_2$ among three groups n=33 per group. A. Comparison of SpO$_2$ at different time points in one single group. ^{εε}, *vs.* T0, P<0.01; *, *vs.* T1, P<0.05; $^{##}$, *vs.* T2, P<0.01; ^{ζ}, *vs.* T3, P<0.05. B. Comparison of SpO$_2$ among three groups at the same time point. **, *vs.* propofol, P<0.01; $^{#}$, *vs.* fentanyl, P<0.05; $^{##}$, *vs.* fentanyl, P<0.01. Two-way ANOVA followed by Tukey's multiple comparison test.

cervical relaxation; and (3) Poor: involuntary intraoperative physical activities which affected operation, requiring additional anesthetics.

Post-operation: When patients woke up, they were asked to evaluate abdominal pain at present (0 min), five minutes (5 min), and fifteen minutes (15 min), respectively. Pain at the time of awakening was recorded to evaluate rate and extent of uterine contraction pain. In this period of time, other complications including respiratory depression, post-operative nausea and vomiting (PONV), shivering, dizziness, drowsiness, asthenia, and other possible adverse effects were recorded individually. Before they were discharged, questionnaires were handed out for the satisfaction survey.

Statistical analysis

Continuous data are presented as mean ± SD and one-way analysis of variance (ANOVA) was performed to detect differences. If data were obtained at different time points, then two-way analysis of variance (two-way ANOVA) was used followed by Tukey's multiple comparison test. Discontinuous data are presented as n (%) and Pearson's Chi-square test; Du Yangzhi's method was used to analyze differences among groups. For ranked data, which referred to anesthetic effect here, Kruskal-Wallis H test was selected to evaluate differences among the three groups, followed by Ridit analysis. Continuous data were processed with GraphPad Prism 6 (Graphpd, San Diego, CA, USA) while discontinuous data used SPSS 23.0 (IBM, New York, USA). P<0.05 was considered as statistically significant.

Results

Basic information of all included patients

Age, weight, and gestational days were collected from all subjects, with no significant differences found among the three groups (**Table 1**).

Comparison of anesthetic effects among three groups

According to criteria mentioned above for assessing anesthetic effects, fentanyl group and butorphanol group presented better effectiveness than the propofol group (P<0.0001, P<0.0001, respectively). There were no significant differences between the former two groups (P=0.064). Results are shown in **Table 2**.

Other parameters associated with anesthetic effect, including recovery time and propofol dosage, showed differences among the three
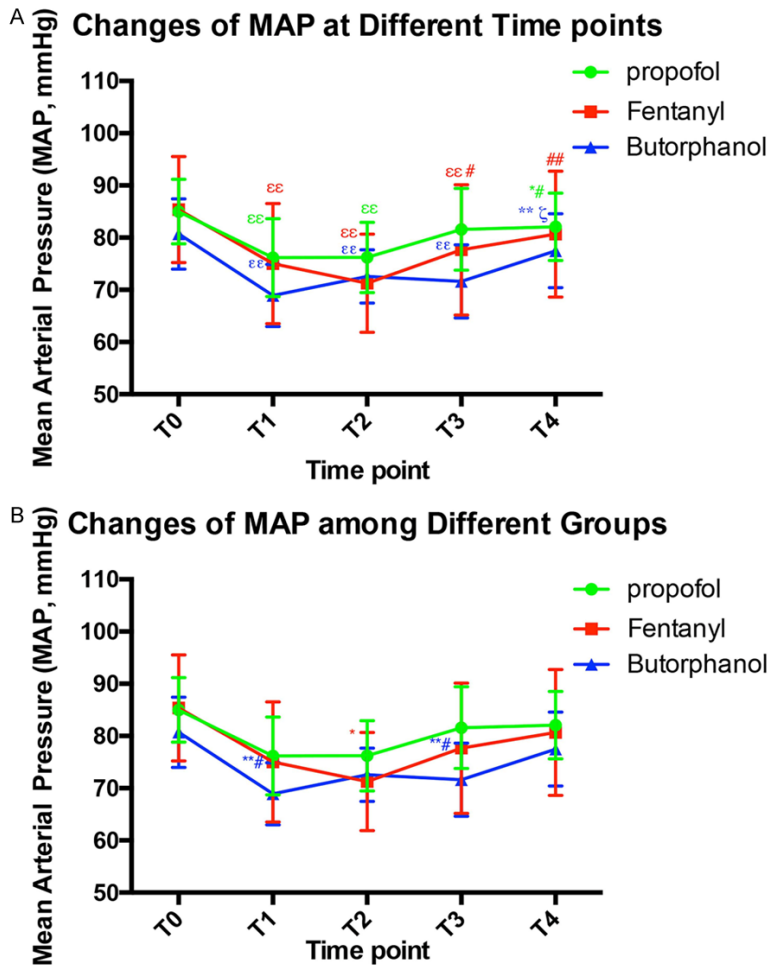
A. Changes of MAP at Different Time points

B. Changes of MAP among Different Groups

Figure 4. MAP trend over time and changes of MAP among three groups n=33 per group. A. Comparison of MAP at different time points in one single group. εε, *vs.* T0, P<0.01; *, *vs.* T1, P<0.05; **, *vs.* T1, P<0.01; #, *vs.* T2, P<0.05; ##, *vs.* T2, P<0.01; ζ, *vs.* T3, P<0.05. B. Comparison of MAP among three groups at the same time point. *, *vs.* propofol, P<0.05; **, *vs.* propofol, P<0.01; #, *vs.* fentanyl, P<0.05; ##, *vs.* fentanyl, P<0.01. Two-way ANOVA followed by Tukey's multiple comparison test.

groups. Butorphanol group presented longer recovery time than the fentanyl group (P= 0.0015) and there were no differences with propofol group (P=0.2416). Although the fentanyl group showed the shortest recovery time, differences were not significant compared with propofol group (P=0.1242).

Consumption of propofol was the greatest in the propofol group, followed by fentanyl group (*vs.* propofol group, P=0.0103). Butorphanol group showed minimum usage of propofol compared with the propofol (P<0.0001) and fentanyl group (P=0.0001).

Differences of onset time of anesthesia and duration of surgery were not statistically signifi-

cant among the three groups. These data are presented in **Table 3**.

Change of vital signs during the operation

HR changes among groups at different time points: Data of HR in propofol group, at five time points, were almost unchanged. They were hardly changed either in fentanyl or butorphanol groups from T0 to T2. HR at T3 was decreased in two groups without significant differences compared with HR at T0 to T2. At T4, HR in fentanyl group was significantly higher than HR at T0, T1, T2 and T3 (P=0.0032, P=0.0157, P= 0.0004, P<0.0001 respectively), while in the butorphanol group it was significantly higher than T1, T2, and T3 (P=0.0239, P=0.0320, P= 0.0045 respectively). Results are shown in **Figure 2A**.

Differences of HR in the three groups were not significant at T0 to T3. At T4, HR in fentanyl and butorphanol group was higher than HR in propofol group (P<0.0001, P=0.0278 respectively). See **Figure 2B**.

SpO$_2$ changes among groups at different time points: The lowest value of SpO$_2$ occurring in all three groups, at any time point, was 92%. This was still within normal range. Differences among groups and five time points were not clinically significant and are not listed here (**Figure 3**).

MAP changes among groups at different time points: MAP in propofol group significantly decreased at T1 and T2 compared with T0 (P=0.0003, P=0.0003 respectively) and T4 (P=0.0386, P=0.0397) and returned to baseline at T4. In fentanyl group, MAP decreased significantly at T1 (*vs.* T0, P<0.0001), reached lowest level at T2 (*vs.* T0, P<0.0001; *vs.* T3, P=0.0189; *vs.* T4, P<0.0001), rose at T3 (*vs.* T0, P=0.0022), and recovered at T4. In butorphanol

Table 4. Incidence of hypotension in three groups

Group	Degree	Occurred once	Occurred twice	Occurred three times	Occurred four times	Total
Propofol	MAP decreased more than 20% of baseline	4 (15.2%)	1 (9.1%)	0 (6.1%)	0 (0.0%)	5 (15.2%)
	MAP decreased more than 30% of baseline	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Fentanyl	MAP decreased more than 20% of baseline	6 (15.2%)	8 (9.1%)	2 (6.1%)	0 (0.0%)	16 (48.5%)**
	MAP decreased more than 30% of baseline	1 (0.0%)[a]	1 (0.0%)[a]	0 (0.0%)	0 (0.0%)	
Butorphanol	MAP decreased more than 20% of baseline	5 (15.2%)	3 (9.1%)	2 (6.1%)	0 (0.0%)	10 (30.3%)
	MAP decreased more than 30% of baseline	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	

Note: Data are presented as n (%), n=33 per group. a: The two patients also had hypotension with MAP lower than 80% of baseline, when calculating the total number, these two data were excluded. **, vs. propofol, P=0.009. Chi-square test followed by Du Yangzhi's method.

Table 5. Prevalence of complications during and after anesthesia

	Propofol (n=33)	Fentanyl (n=33)	Butorphanol (n=33)	P value
Respiratory depression	1 (3.0%)	2 (6.1%)	0 (0.0%)	0.771
PONV	2 (6.1%)	1 (3.0%)	0 (0.0%)	0.771
Dizziness	6 (18.2%)	16 (48.5%)**	6 (18.2%)##	0.007
Drowsiness	0 (0.0%)	1 (3.0%)	26 (78.8%)**,##	<0.001
Asthenia	0 (0.0%)	2 (6.1%)	0 (0.0%)	0.327

Note: All data are presented as n (%), n=33 per group. For dizziness: **, vs. propofol, P=0.009; ##, vs. fentanyl, P=0.009. For drowsiness: **, vs. propofol, P<0.001; ##, vs. fentanyl, P<0.001. Chi-square test or Fisher's exact probability followed by Du Yangzhi's method. PONV, post-operative nausea and vomiting.

group, MAP decreased at T1 (vs. T0, P<0.0001), slightly rose at T2 (vs. T0, P=0.0010), and decreased again at T3 (vs. T0, P=0.0002), then returned to baseline at T4 (vs. T1, P=0.0004; vs. T3, P=0.0404). See **Figure 4A**.

Data of MAP in the three groups were significantly different at T1, T2 and T3. At T1, butorphanol group showed the lowest MAP compared with propofol (P=0.0015) and fentanyl (P=0.0100) group. At T2, MAP in fentanyl group was the lowest (vs. propofol, P=0.0472, vs. butorphanol, P=0.8044). At T3, butorphanol group presented the lowest MAP than fentanyl (P=0.0111) and propofol (P<0.001) group. Differences between the other two groups at T1, T2 and T3 were not significant (**Figure 4B**).

Comparison of incidence of hypotension among the three groups

Incidence of hypotension in the fentanyl group was the highest compared to the other two groups (vs. propofol, P=0.009; vs. butorphanol, P=0.131), followed by the butorphanol group, although differences were not significant. Data are listed in **Table 4**.

Comparison of incidence of adverse effects among the three groups

Incidence of respiratory depression, PONV, and asthenia in three groups showed no differences (P=0.771, P=0.771, P=0.327 respectively). Fentanyl group had higher incidence of dizziness than the other two groups (P=0.009, P=0.009, respectively). Incidence of dizziness in propofol and butorphanol groups was the same (18.2%). For drowsiness, butorphanol groups presented significantly higher incidence than propofol and fentanyl group (P<0.001, P<0.001 respectively), with the latter two groups showing almost no drowsiness with incidences of 0.0% and 3.0%, respectively. Shivering and other possible side effects were also observed with no cases occurring in this trial (**Table 5**).

Comparison of VAS scores of uterine contraction pain after surgery among the three groups

VAS scores were highest at 0 minutes and declined with time in all three groups. In propofol group, VAS scores at 5 minutes were lower than 0 minutes (P=0.0094), while at 15 minutes they were lower than 0 minutes (P<0.0001) and 5 minutes (P=0.0467). For fentanyl group, however, differences were not significant at three time points. Trends of VAS scores in the butorphanol group were consistent with that of propofol and butorphanol group and scores at 15 minutes were the lowest compared with 0 minutes (P=0.0194) and 5 minutes (P=0.6898). Data is shown in **Figure 5A**.
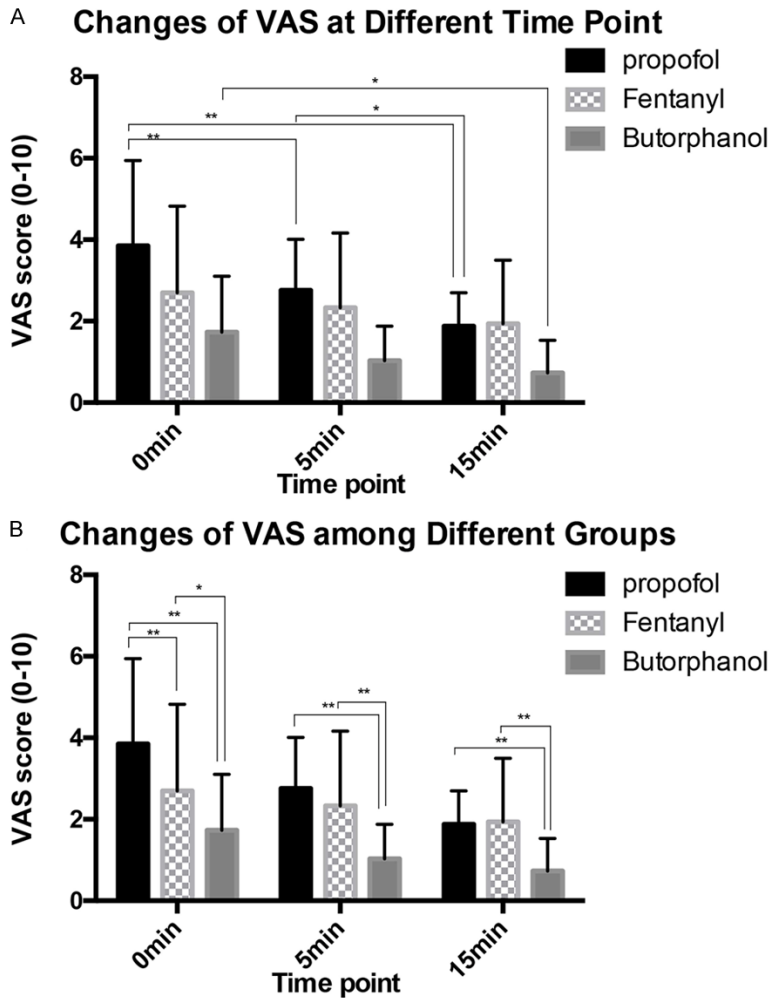
A. Changes of VAS at Different Time Point

B. Changes of VAS among Different Groups

Figure 5. VAS scores at different time points among three groups. A. Comparison of VAS scores at different time points in one single group. B. Comparison of VAS scores among three groups at the same time point. n=33 per group. *, P<0.05; **, P<0.01. Two-way ANOVA followed by Tukey's multiple comparison test.

Table 6. Incidence and severity of uterine contraction pain at 0 minutes after induced abortion

Degree \ Group	Propofol	Fentanyl	Butorphanol	P value
Mild	14 (42.0%)	16 (48.5%)	20 (60.6%)	
Moderate	13 (39.0%)	8 (24.2%)	5 (15.2%)	
Severe	4 (12.0%)	3 (9.1%)	0 (0.0%)	
Incidence	31 (94.0%)	27 (81.8%)	25 (75.8%)	0.124
P value		0.069[a]	0.001**	0.003

Note: Data are shown as n (%), n=33 per group. For pain degree, **, vs. propofol; Fentanyl vs. butorphanol, P=0.096. a, vs. propofol. Kruskal-Wallis H test followed by Ridit analysis. For total incidence of uterine contraction pain, Chi-square test was performed.

Differences in the three groups at the same time points were significant. At 0 minutes, VAS scores in propofol group were obviously higher than fentanyl (P=0.0056) and butorphanol (P<0.0001) groups; Differences between the latter two were also significant and fentanyl group showed lower VAS scores (P=0.0244). At 5 minutes, the situation among three groups was consistent with that of 0 minutes. VAS scores in butorphanol group were lower than fentanyl (P=0.0014) and propofol (P<0.0001) group, but statistical differences between the latter two groups were not significant. At 15 minutes, assessment of pain in fentanyl group showed the highest scores compared with propofol (P=0.9852) and butorphanol (P=0.0033) group. Butorphanol group displayed lower VAS scores than propofol group (P=0.0056). Data are summarized in **Figure 5B**.

Comparison of incidence and degree of pain among the three groups

As described above, incidence of uterine contraction pain after induced abortion was the lowest in butorphanol group, followed by the fentanyl group. However, differences among three groups were not significant. For pain degree, butorphanol group demonstrated less pain compared with the propofol group (P= 0.001). Fentanyl group and propofol group showed no statistical differences in pain degree (**Table 6**).

Satisfaction survey of all included patients

All three interventions got high praise. Satisfaction of pain relief in propofol, fentanyl, and butorphanol group was 90.9%, 93.9% and 100%,

Table 7. Satisfaction surveys of all included patients after surgery

Questions / Groups	Propofol	Fentanyl	Butorphanol
Is this anesthesia helpful for pain relief?			
Yes, totally.	30 (90.9%)	31 (93.9%)	33 (100%)
Yes, partly.	3 (9.1%)	2 (6.1%)	0 (0.0%)
No, not at all.	0 (0.0%)	0 (0.0%)	0 (0.0%)
Do you satisfy with this anesthesia?			
Yes, very satisfied.	26 (78.8%)	28 (84.8%)	31 (93.9%)
Yes, kind of.	7 (21.2%)	5 (15.2%)	2 (6.1%)
No, not at all.	0 (0.0%)	0 (0.0%)	0 (0.0%)
Are there any deficiencies of this anesthesia?			
Yes.	0 (0.0%)	0 (0.0%)	0 (0.0%)
No.	18 (54.5%)	17 (51.5%)	22 (66.7%)
Unclear.	15 (45.5%)	16 (48.5%)	11 (33.3%)

Note: All data are presented as n (%), n=33 per group.

respectively, while overall satisfaction was 78.8%, 84.8% and 93.9%, respectively. All patients denied any unpleasant experiences and did not point out any deficiencies. Data are shown in **Table 7**.

Discussion

Induced abortion is a very common minor surgery in China. Uterine contraction pain, after surgical abortion, severely affects the post-operation recovery and well-being of patients. Through intensive observation of two common analgesics (fentanyl and butorphanol) used in surgical induced abortion, this study found that, in terms of basic anesthetic effects, butorphanol and fentanyl combined with propofol were almost indistinguishable, but were better than simply using propofol. Recovery time of butorphanol combined with propofol anesthesia was slightly longer than that of fentanyl and consumption of propofol was less in the butorphanol group. The reason might be the sedative effects and shorter half-time period of butorphanol.

Regarding changes in vital signs during surgery, HR and SpO_2 showed minor fluctuations in the three groups. Strong stimulation, such as vacuum suction, did not alert HR, indicating excellent anesthetic effects of butorphanol and fentanyl combined with propofol. Raise of HR after recovery might be due to post-operation pain and removal of inhibitory effects of propofol on the sympathetic nerve activity [20]. SpO_2 was relatively stable under continuous

inhalation of oxygen. Although respiratory depression occurred in three patients, there were no adverse consequences after timely assisted breathing, thus, oxygen supply was not disturbed. Blood pressure exhibited obvious changes during surgery in all groups, especially in the fentanyl group. Incidence of hypotension in fentanyl group was the highest compared with the other two groups. Dwivedi and his colleagues found that butorphanol combined with propofol was more effective in stabilizing hemodynamics than fentanyl [21]. One randomized controlled trial, focused on early ambulation after urological surgery in the elderly, demonstrated less breathing and circulation side effects with the use of butorphanol in spinal canal compared with the use of fentanyl [19]. These results are consistent with this present study, except for incidence of drowsiness, which was higher in butorphanol group. Drowsiness is a very common adverse effect of butorphanol in clinical practice. The long half-time period of butorphanol and short operative time might also result in drowsiness. However, no patients were affected by this side effect. Another research concerning analgesic effects and incidence of adverse effects in open gallbladder surgery showed that efficacy of butorphanol combined with propofol was better than fentanyl combined with propofol and consumption of propofol was less in the former combination [22].

Uterine contraction pain after surgical induced abortion is a kind of visceral pain located deep in the body. After surgery, uterine contractions

lead to the release of lots of noxious chemical mediators including bradykinin, leukotrienes, prostaglandin, 5-hydroxytryptamine, lactic acid, and substance P, which are involved in pain perception [23]. Opioids could bind to corresponding opioid receptors, distributed in dorsal root ganglion and the brain, to block the transmission of pain signals [24]. NSAIDs suppress the release of inflammatory factors to manage mild to moderate pain [25]. These two kinds of drugs are very commonly and effectively used in the clinical treatment of uterine contraction pain after induced abortion. Results of this present study demonstrated that, when comparing fentanyl-propofol combined anesthesia with simple use of propofol, butorphanol combined with propofol presents better effects both on pain intensity at the time when patients are awakening and on VAS scores at different time points. This indicates that butorphanol might be more suitable for preventing post-operative uterine contraction pain in patients undergoing surgical induced abortion under intravenous anesthesia. In addition, butorphanol has shown better analgesic effects than fentanyl for pain in early stages of labor, related with uterus contraction and cervix dilatation [9]. These results are also consistent with this present study, suggesting that butorphanol has better therapeutic and prophylactic effects on pain caused by uterine contractions compared with fentanyl.

Other research studies have demonstrated good analgesic effects of NSAIDs for treating uterine contraction pain. However, issues including extra drugs, relatively expensive prices, and patient affordability have restricted the use of NSAIDs [9]. If possible, the effects of opioids and NSAIDs should be compared, in the near future, to provide potential treatment methods for this pain.

In this study, satisfaction surveys were filled out after surgery, showing that total satisfaction rates were very similar and no one reported any disadvantages with the three methods. From the perspective of physiological indicators or psychological experience, the methods and drugs, especially butorphanol, used in anesthesia were safe and effective in providing intraoperative and postoperative analgesia for patients.

This present study has some limitations. Prolonged follow up after surgery was not conducted because of rapid recovery, both to anesthesia and to surgery. Most of the patients were not willing to leave contact details, thus, questionnaires may be unreliable.

In conclusion, the anesthetic effects of butorphanol and fentanyl are very good in cases of induced abortion. Use of butorphanol might diminish the consumption of propofol and slightly delay recovery time. Incidence of complications was lower, except for drowsiness, when using butorphanol. The impact of butorphanol on vital signs, especially blood pressure, was relatively small. VAS scores of postoperative uterine contraction pain in the butorphanol group were also lower, although overall satisfaction rates were nearly the same in all three groups. Based on safety, efficacy, and economic considerations, butorphanol is suitable for intravenous anesthesia for induced abortion and for treatment and prevention of postoperative uterine contractions.

Disclosure of conflict of interest

None.

Address correspondence to: Peng Huang, Department of Gynaecology and Obstetrics, Maternity and Child Health Care Hospital of Huanggang City, No.31 Huangzhou Avenue, Huanggang 438000, Hubei Province, China. Tel: +86-15377133612; E-mail: huangpeng888h@163.com

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