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Effect of hydromorphone applied in the gynecological laparoscopic operation and its effect on the hemodynamics and inflammatory cytokines

Chong−Lai Shi[1], Song−Tao Zhou[2], Xiao−Gang Li[1]✉

[1.] *Department of Anesthesiology, People's Hospital of Yangxin County, Hubei, 435200*

[2.] *Department of Pharmacy, People's Hospital of Yangxin County, Hubei, 435200*

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ABSTRACT

Objective: To study the effect of hydromorphone applied in the gynecological laparoscopic operation and analyze its effect on the hemodynamics and inflammatory cytokines. **Methods:** A total of 170 patients who were underwent selective gynecological laparoscopic operation under general anesthesia were included in the study and randomized into the observation group (n=85) and the control group (n=85). On the basis of routine anesthesia, the patients in the observation group were given hydromorphone, while the patients in the control group were given fentanyl. The hemodynamic changes in different timing points in the two groups were observed and compared. The levels of serum inflammatory cytokines and stress reaction indicators in the two groups were detected and compared. **Results:** HR, SBP, and MAP at T2 in the observation group were significantly reduced when compared with at T1, those at T3 were recovered to levels at T1. HR, SBP, and MAP at T2 and T3 in the control group were significantly reduced, and those were significantly lower than those in the observation group. IL-6, IL-10, and TNF-α levels 24 h after anesthesia in the two groups were significantly elevated when compared with before anesthesia. IL-10 level in the observation group was significantly higher than that in the control group, while IL-6 and TNF-α were significantly lower than those in the control group. CRP, FC, A, and NE levels 24 h after anesthesia in the two groups were significantly reduced, and those in the observation group were significantly lower than those in the control group. **Conclusions:** Hydromorphone applied in the gynecological laparoscopic operation will not produce great effect on the hemodynamics, with small stress reaction and mild inflammatory reaction; therefore, it is more beneficial for the postoperative recovery.

1. Introduction

Currently, with the rapid development of medical technology, due to simple operation, small intraoperative trauma, rapid postoperative rehabilitation, and less complications, the laparoscopy is gradually becoming the routine surgical method in the treatment of gynecological diseases[1]. The laparoscopy is a kind of minimally invasive technology, but the establishment of intraoperative CO_2 pneumoperitoneum will bring effects on the body in different degree, and can cause intraoperative inflammatory reaction and increase the pain to reduce the surgical efficacy with no effective processing; therefore, the gynecological laparoscopic operation proposes a higher requirement for the clinical anesthesiologists in order to guarantee the reasonable and safe anesthesia methods before operation and the success of operation[2,3]. The study is aimed to explore the effect of hydromorphone applied in the gynecological laparoscopic operation and its effect on the hemodynamics, inflammatory cytokines, and stress reaction.

✉Corresponding author: Chong-Lai Shi, Department of Anesthesiology, People's Hospital of Yangxin County, Hubei, 435200.
Tel: 13986576866
E-mail: docshiconglai@126.com
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2. Materials and methods

2.1. General materials

A total of 170 patients who were underwent selective gynecological laparoscopic operation under general anesthesia were included in the study. Exclusion criteria: (1) those who had a history of alcoholomania and a history of drug abuse; (2) those who were merged with morbid obesity; (3) those who had contraindications to the drugs in the study; (4) those who had coagulation and hematopoietic dysfunction; (5) those who were merged with severe cardiovascular and cerebrovascular diseases; (6) those who had severe liver, kidney, and other organs damage; (7) those who had poor compliance and could not cooperate in requirement. The study was approved by the Ethical Committee of our hospital, and informed consents were obtained from all the patients and relatives. All the patients were randomized into the observation group and the control group with 85 cases in each group. In the observation group, the patients were aged from 28 to 65 years old, with an average age of (43.89±4.27); ASA grading: 46 at grade I, and 39 at grade II; weight from 52 to 73 kg, with an average weight of (60.11±4.21) kg. In the control group, the patients were aged from 27 to 64 years old, with an average age of (44.72±4.15); ASA grading: 45 at grade I, and 40 at grade II; weight from 53 to 74 kg, with an average weight of (61.28±4.19) kg. The comparison of age, ASA grading, and weight between the two groups was not significantly different (P>0.05), but it was comparable.

2.2. Methods

All the patients were strictly deprived of water and fasting for 8 h. The patients and their relatives were informed of the anesthetics and positions taken before operation by the anesthesiologist. After entering the operation room, a venous channel was established in order to implement general anesthesia. The patients in the observation group were given intravenous injection of hydromophone hydrochloride, 0.5 mg/time, while the patients in the control group were given intravenous injection of fentanyl, 4 μg/kg. 10 min after medication, the patients were given intravenous injections of propofol (2-3 mg/kg), cisatracurium besilate (0.15 mg/kg), and midazolam (0.04 mg/kg) for anesthesia induction. After loss of consciousness, tracheal intubation was performed. Propofol in combined with fentanyl were used for deep anesthesia maintenance. During the anesthesia period, pay close attention to the changes of vital signs.

2.3. Observation indicators and efficacy estimation criteria

(1)The hemodynamic related indicators, including HR, SBP, and MAP 5 min after entering the operation room (T1), at the time of intubation (T2), and 10 min after extubation (T3) were measured and recorded, respectively. (2) A volume of 3 mL morning fasting venous blood before anesthesia and 24 h after anesthesia in the two groups was collected, centrifuged at 3 500 r/min for the serum, and preserved for detection. ELISA was used to detect IL-6, IL-10, TNF-α, CRP, FC, A, and NE levels.

2.4. Statistical analysis

SPSS 20.0 software was used for the statistical analysis. The measurement data were expressed as mean ± SD, the paired t test was used for the intra-group comparison, while the independent t test was used for the comparison between the two groups. P<0.05 was regarded as statistically significant.

3. Results

3.1. Comparison of the hemodynamics in each timing point between the two groups

HR, SBP, and MAP at T2 in the observation group were significantly reduced when compared with at T1 (P<0.05 or P<0.01), those at T3 were recovered to levels at T1 (P>0.05). HR, SBP, and MAP at T2 and T3 in the control group were significantly reduced (P<0.01), and those were significantly lower than those in the observation group (P<0.05 or P<0.01) (Table 1).

Table 1.
Comparison of the hemodynamics in each timing point between the two groups.

Indicators	Timing point	Observation group (n=85)	Control group (n=85)
HR	T1	73.59±10.18	73.48±9.87
	T2	69.11±12.93	65.02±15.68
	T3	72.51±10.22	66.63±8.44
SBP	T1	126.49±5.39	126.51±5.28
	T2	115.37±4.21	104.15±3.26
	T3	125.52±4.95	112.61±4.03
MAP	T1	95.49±12.34	95.36±11.88
	T2	90.37±17.03	84.05±16.43
	T3	94.37±10.51	91.97±8.46

P<0.05， P<0.01, when compared with at T1； P<0.05， P<0.01, when compared with the control group.

Table 2.
Comparison of the levels of inflammatory cytokines before anesthesia and 24 h after anesthesia between the two groups.

Groups	Time	IL-6	IL-10	TNF- α
Observation group (*n*=85)	Before anesthesia	29.55±8.24	8.61±2.21	23.65±3.19
	24 h after anesthesia	32.74±9.31	35.64±8.73	40.58±4.36
Control group (*n*=85)	Before anesthesia	29.61±8.30	8.67±2.20	23.54±3.24
	24 h after anesthesia	36.31±9.25	30.16±8.52	67.66±4.81

P<0.05, *P*<0.01, when compared with before anesthesia; *P*<0.05, *P*<0.01, when compared with the control group.

Table 3.
Comparison of the levels of stress indicators before anesthesia and 24 h after anesthesia between the two groups.

Groups	Time	CRP	FC	A	NE
Observation group (*n*=85)	Before anesthesia	21.31±3.84	59.49±6.41	74.18±9.06	138.45±17.24
	24 h after anesthesia	15.36±4.03	52.11±5.36	67.32±8.15	124.72±9.06
Control group (*n*=85)	Before anesthesia	21.28±3.79	60.57±5.82	73.49±8.87	137.62±16.53
	24 h after anesthesia	16.62±3.54	58.41±6.01	70.25±6.43	130.55±8.96

P<0.05, *P*<0.01, when compared with before anesthesia; *P*<0.05, *P*<0.01, when compared with the control group.

3.2. Comparison of the levels of inflammatory cytokines before anesthesia and 24 h after anesthesia between the two groups

IL-6, IL-10, and TNF- α levels 24 h after anesthesia in the two groups were significantly elevated when compared with before anesthesia (*P*<0.05 or *P*<0.01). IL-10 level in the observation group was significantly higher than that in the control group, while IL-6 and TNF- were significantly lower than those in the control group (*P*<0.05 or *P*<0.01) (Table 2).

3.3. Comparison of the levels of stress indicators before anesthesia and 24h after anesthesia between the two groups

CRP, FC, A, and NE levels 24 h after anesthesia in the two groups were significantly reduced (*P*<0.05 or *P*<0.01), and those in the observation group were significantly lower than those in the control group (*P*<0.05 or *P*<0.01) (Table 3).

4. Discussion

When compared with the traditional laparotomy, the gynecological laparoscopic operation has an outstanding advantage, but the pain on the shoulders, hypochondria, and incision due to tissue damage is inevitable, while the shoulder pain is the most common type of non-incision pain, with an occurrence rate reaching 35%-80%; meanwhile, the establishment of intraoperative pneumoperitoneum can cause acute expansion of peritoneum, with great stimulation, thus promoting the secretion of a large amount of inflammatory mediators and pain-induced mediators[4,5]. Some researches demonstrate that[6] selection of reasonable anesthesia methods before anesthesia can effectively reduce the adverse reactions, and can contribute to the prognosis.

Fentanyl or hydromorphone is often adopted in the clinic for analgesia. Fentanyl can effectively inhibit the stress reaction caused by tracheal intubation, and protect the body, but it can aggravate the stimulation on the vagus nerve, and inhibit the sympathetic nerve, thus resulting in abnormal fluctuation of hemodynamics. Hydromorphone belongs to opiates synthetic drug, with similar effect as morphine, has strong analgesic effect which is 6-10 times of morphine, whose affinity with the receptors is further higher than that of morphine, and can rapidly act on the central nervous system, with long duration and less adverse reactions[7–9]. The gynecological laparoscopic operation is a minimally invasive operation, but the tracheal intubation under general anesthesia will induce the fluctuation of various stress reaction indicators, leading to a large amount release of catecholamine and resulting in HR acceleration and blood pressure elevation, but excessive stress reaction will aggravate the myocardial oxygen consumption, and increase the risk of cardiovascular damage, causing the abnormality of various hemodynamic indicators; meanwhile, the stimulation will cause the obvious elevation of adrenocortical hormone level; moreover, with the continuous occurrence of stimulation, FC, A, and NE levels released by adrenal medulla are also elevated, which can indirectly reflect the stress reaction degree[10,11]. Currently, there are many reports on hydromorphone applied in the surgical analgesia in the clinic, but its effect on the hemodynamics and stress reaction during the gynecological laparoscopic operation is less reported[12,13]. The results in the study showed that HR, SBP, and MAP at T2 in the observation group were significantly reduced when compared with at T1 (*P*<0.05 or *P*<0.01), those at T3 were recovered to levels at T1 (*P*>0.05); HR, SBP, and MAP at T2 and T3 in the control group were significantly reduced (*P*<0.01), and those were significantly lower than those in the observation group (*P*<0.05 or *P*<0.01); CRP, FC, A, and NE levels 24 h after anesthesia in the two groups were significantly reduced (*P*<0.05 or *P*<0.01), and those in the

observation group were significantly lower than those in the control group (P<0.05 or P<0.01), indicating that hydromorphone applied in the gynecological laparoscopic operation has small effect on the hemodynamics and will not produce great stress reaction. A large stimulation can change the levels of inflammatory cytokines and affect the immunological system and endocrine system, among which IL-6 is a pro-inflammatory mediator, and is a sensitive indicator to evaluate the inflammatory reaction; IL-10 is an anti-inflammatory mediator, can effectively inhibit the release of pro-inflammatory mediators, and protect the immunological system; TNF-α an activator of inflammatory reaction, and can promote the secretion and release of various inflammatory cytokines[14,15]. The results in the study showed that IL-6, IL-10, and TNF-α levels 24 h after anesthesia in the two groups were significantly elevated when compared with before anesthesia (P<0.05 or P<0.01); IL-10 level in the observation group was significantly higher than that in the control group, while IL-6 and TNF-α were significantly lower than those in the control group (P<0.05 or P<0.01), indicating that hydromorphone applied in the gynecological laparoscopic operation can effectively control the occurrence and development of inflammatory reaction, which is similar to related reports[16].

In conclusion, hydromorphone applied in the gynecological laparoscopic operation has a small effect on the hemodynamics, can effectively alleviate the stress reaction, and contribute to control the progression of inflammatory reaction, with an accurate efficacy; therefore, it deserves to be widely recommended in the clinic.

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