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Effects of sevoflurane or propofol combined with remifentanil anesthesia on clinical efficacy and stress response in pregnant women with pregnancy-induced hypertension

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Abstract. – OBJECTIVE: To compare the effects of sevoflurane or propofol combined with remifentanil anesthesia on the clinical efficacy and stress response of pregnancy-induced hypertension (PIHS) in cesarean section.

PATIENTS AND METHODS: 150 patients with PIHS and treated with cesarean section in our hospital from May 2015 to September 2016 were selected. All patients were randomly divided into sevoflurane-remifentanil group (n=75) and propofol-remifentanil (n=75). The elbow blood of patients in both groups were collected, the levels of Norepinephrine (NE) adrenaline (AD), cortisol and blood glucose in plasma were compared at before anesthesia induction (T_0), operation 30 min (T_1), end of operation (T_2), 2 h after operation (T_3), 24 h after operation (T_4). The blood pressure control, muscle control, anesthesia onset time, maternal pain and complications were compared between the two groups.

RESULTS: The patients in the sevoflurane group were superior to the propofol group ($p<0.05$) in terms of muscle control effect, anesthesia onset time and maternal pain. There was no significant difference between the two groups in terms of blood pressure control and anesthesia complications ($p>0.05$). There was no significant difference in plasma AD, NE, cortisol and blood glucose between the two groups before induction of anesthesia ($p>0.05$). However, the plasma markers of the two groups began to increase after anesthesia induction and reached peak at T_2 or T_3, returned back to preoperative level or higher than before surgery at T_4. The levels of AD, NE, cortisol and blood glucose in plasma of sevoflurane group were significantly lower than those in propofol group at T_1-T_4 time point, the difference was statistically significant ($p<0.05$).

CONCLUSIONS: The clinical efficacy of sevoflurane combined with remifentanil anesthesia is better than that of propofol combined with remifentanil, and it can effectively reduce the stress of pregnant women with pregnancy-induced hypertension treated with cesarean section.

Key Words:
Anesthesia, Pregnancy induced-hypertension, Stress response.

Introduction

Pregnancy-induced hypertension syndrome (PIHS) is the most important cause of increased mortality in pregnant women, and cesarean section for childbirth is a high safety operation for pregnant women with pregnancy-induced hypertension[1,2]. Anesthesia and surgical operation can cause the stress response of the organs, severe stress response will further lead to reduced immune function in patients, and thus affect the patient's long-term efficacy and prognosis[3,4]. Related studies[5-7] have reported that remifentanil anesthesia can inhibit the body sympathetic nerve excitement, reduce adrenaline (AD) and norepinephrine (NE) secretion, thereby reducing the degree of stress response.

The sevoflurane was first discovered by Ross Terrell and was synthesized by Regan in 1968, Phase III clinical trials were completed in 1986, and first approved by the Japanese Drug Administration in 1990 for clinical use. Propofol is often used with analgesics, muscle relaxants and inhalation anesthetics, and applicable to outpatients. In this investigation, we observed the changes of adrenaline, norepinephrine, cortisol, and glucose in the serum of cesarean section patients with PIHS by observing the two anesthesia methods of

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Table I. General clinical data for both groups of patients.

Group	Number of cases	Age (year)	Body weight (kg)	Operation time (min)	Blood loss (ml)
Propofol - remifentanil	75	28.27±7.38	63.45±21.49	164.49±38.52	353.59±74.21
Sevoflurane - remifentanil	75	30.18±6.34	61.43±19.54	173.28±31.53	362.19±65.74
t/χ^2		5.439	21.384	8.549	16.842
p		0.387	0.195	0.315	0.223

sevoflurane or propofol combined with remifentanil. The aim of this study was to investigate the effects of different anesthesia methods on stress response in cesarean section patients with PIHS.

Patients and Methods

Patients

150 patients with PIHS and treated with cesarean section in Daqing Longnan Hospital from May 2015 to September 2016 were selected, aged 23-37 years, and the mean age was 29.48 ± 7.29 years old. All patients were excluded preoperative cardiac dysfunction. 150 cases of PIHS cesarean section patents were randomly divided into sevoflurane-remifentanil group and propofol-remifentanil group, each group had 75 cases. There was no statistically significant difference between the two groups in age, time of operation and intraoperative blood loss ($p > 0.05$, Table I). This study has been approved by the Medical Ethics Committee of Daqing Longnan Hospital. All the patients and their families have signed the informed consent.

Methods

Anesthesia induction: Both groups of patients accepted intravenous injection of midazolam (SFDA Approval No. H10980025, Jiangsu Enhua Pharmaceutical Co., Ltd., Jiangsu, China) 0.1 mg/kg, propofol 2 mg/kg, remifentanil 5-8 μg/kg. After BIS reached 45 h, rocuronium 0.8 mg/kg was administrated, tracheal intubation was established for continuous mechanical ventilation, pressure of end-tidal Carbon Dioxide ($PETCO_2$) was maintained at 30-35 mmHg. Anesthesia maintenance: after the anesthesia induction, for the sevoflurane-remifentanil group, continued inhalation of sevoflurane (concentration of 2%-3%) was maintained till the end of the surgery, for the propofol-remifentanil group, and propofol was infused by micropump at 3-5 mg/kg/h.

Observation Indicators

3 ml of the elbow blood of patients in both groups were collected in EDTA tubas at before anesthesia induction (T_0), operation 30 min (T_1), end of operation (T_2), 2 h after operation (T_3), 24 h after operation (T_4). The blood was centrifuged at 2500 r/min for 20 min; then, the supernatant was obtained and preserved at -80°C for further detection. The levels of AD and NE in the plasma were measured by high-performance liquid chromatography (HPLC), and plasma cortisol was measured by radioimmunoassay. Blood glucose was measured by oxidase method.

Statistical Analysis

SPSS 22.0 (IBM SPSS Statistics for Windows, IBM Corp., Armonk, NY, USA) statistical analysis software was used to analyze the data. The measurement data were expressed as mean ± standard deviation, *t*-test was used to compare between groups, and the variance analysis of repeated measurements was used to compare data at different time points in the group. Enumeration data were expressed as percentage; chi-square test was used for comparison between groups. $p<0.05$ for the difference was considered as statistically significant.

Results

Comparison of the General Clinical Data Between the Two Groups of Patients

There was no statistically significant difference between the two groups in terms of age, body weight, operation time and intraoperative blood loss ($p> 0.05$) (Table I).

Changes in Plasma Markers After Induction of Anesthesia and After Surgery

There was no significant difference in AD, NE, cortisol and blood glucose between the two groups before induction of anesthesia ($p > 0.05$), but the plasma marker levels of the two groups began to increase after anesthesia induction, reached peak at T_2 (end of surgery) or T_3 (2 h after operation), and returned to preoperative level or higher than preoperative level at T_4 (24 h after operation). The levels of AD, NE, cortisol and blood glucose in plasma of the sevoflurane group were significantly lower than those in propofol group ($p<0.05$) (Tables II-V).

Table II. Plasma AD levels (pmol/L) at each time point in both groups.

Group	Number of cases	T_0	T_1	T_2	T_3	T_4
Propofol - remifentanil	75	478.23±58.65	493.69±69.53	551.58±83.58*	542.38±79.69*#	501.45±54.79
Sevoflurane - remifentanil	75	479.28±57.69	386.29±55.38	521.57±65.20*#	493.29±64.18*	485.47±51.28
t		0.589	1.884	3.894	3.993	1.573
p		0.164	0.015	0.005	0.005	0.022

Note: *means that the AD level at T_2 (end of surgery) and T_3 (postoperative 2h) increased compared with T_0, the difference was statistically significant; # means that AD reached peak.

Table III. Plasma NE levels (nmol/L) at each time point.

Group	Number of cases	T_0	T_1	T_2	T_3	T_4
Propofol - remifentanil	75	1.42±0.21	1.65±0.32	1.94±0.43	1.87±0.41	1.61±0.19
Sevoflurane - remifentanil	75	1.44±0.23	1.25±0.21	1.73±0.38	1.55±0.31	1.47±0.08
t		0.819	3.791	4.289	3.578	1.215
p		0.139	0.006	0.004	0.007	0.026

Table IV. Plasma cortisol levels at each time points (pg/ml).

Group	Number of cases	T_0	T_1	T_2	T_3	T_4
Propofol - remifentanil	75	201.48±21.48	274.38±25.48	299.47±32.58	285.37±28.41	258.32±24.39
Sevoflurane - remifentanil	75	203.18±24.41	249.37±24.36	278.47±28.79	265.47±22.58	226.18±22.34
t		0.673	2.699	5.472	4.893	1.689
p		0.157	0.010	0.001	0.002	0.018

Table V. Blood sugar levels (mmol/L) at each time point.

Group	Number of cases	T_0	T_1	T_2	T_3	T_4
Propofol - remifentanil	75	5.58±0.24	6.07±0.25	6.57±0.31	6.67±0.34	6.48±0.47
Sevoflurane - remifentanil	75	5.63±0.29	5.89±0.23	6.16±0.34	6.36±0.32	6.12±0.37
t		0.479	5.782	4.219	2.983	2.574
p		0.173	0.000	0.002	0.009	0.011

Discussion

Surgery and anesthesia can cause a series of negative emotions in patients, the occurrence of pain after the surgery will also lead to the occurrence of stress response[8,9]. The body's stress response is mainly manifested in the impact of endocrine function, such as increased levels of plasma AD and NE, excessive secretion of hormones and lack of hormone synthesis further leading to increased blood pressure, increased blood sugar, heart rate and other adverse symptoms[10,11]. Studies[12,13] have reported that the stress response during surgery is greater than the stress response induced by anesthesia. But for clinicians, it is often not very realistic to reduce the patient's stress response by changing the surgical approach. Therefore, in the actual operation, it is of great significance to choose the appropriate anesthesia method and narcotic drugs to reduce the patient's stress response for the far period efficacy of the operation and quality of life of patients.

Researches[14,15] have found that remifentanil anesthesia can block the conduction of peripheral stimuli, inhibit the body's sympathetic nerve excitement, and reduce norepinephrine and adrenaline secretion, so the use of general anesthesia combined with remifentanil anesthesia can reduce the stress response induced by endotracheal and surgical procedures, therefore improve the patient's endocrine function and internal stability. The results of this study show that plasma levels of AD and NE in both groups began to increase after anesthesia induction and reached a peak at T_2 or T_3, and returned to preoperative levels at T_4. Compared with propofol-remifentanil group, the levels of AD and NE in plasma were significantly lower than those in cesarean section patients with PIHS treated with sevoflurane combined with remifentanil ($p<0.05$). The results suggest that the use of sevoflurane combined with remifentanil anesthesia can effectively reduce the norepinephrine and epinephrine secretion of cesarean section patients with PIHS.

Cortisol has a high sensitivity to the body's stress response. The level of cortisol in plasma is affected by any stimulus in the body and closely related to the duration of surgery and the intensity of stimulation[16,17]. Studies have reported that tracheal intubation, extubation, and surgical procedures can lead to the generation of stress response in patients, resulting in increased sympathetic nerve activity, increased activity and increased plasma cortisol levels[18]. Blood glucose levels are important for assessing stress response in patients. Studies have reported that the increase in adrenal hormones will inhibit the body's use of glucose, and the increase in plasma cortisol levels will further reduce the use of glucose in the body, resulting in increased blood glucose levels in patients[19]. The results of this study showed that cortisol and blood glucose levels in both groups began to rise after induction of anesthesia and reached a peak at T_2 or T_3, and followed by a decrease but higher than before induction of anesthesia. The levels of cortisol and blood glucose in the plasma of sevoflurane-remifentanil group were significantly higher than those of propofol-remifentanil group, and the difference was statistically significant ($p<0.05$). It is suggested that the anesthesia method of sevoflurane combined with remifentanil can effectively inhibit the secretion of cortisol and blood glucose in cesarean section patients with PIHS. Sevoflurane has also played an analgesic effect while playing anesthesia effect, but propofol anesthetic has only anesthetic effect but no analgesic effect, and propofol anesthesia may cause respiratory depression.

Conclusions

In the cesarean section for PIHS maternal, the clinical efficacy of sevoflurane combined with remifentanil anesthesia is better than propofol combined with remifentanil, and sevoflurane combined with remifentanil anesthesia can effectively reduce the stress response of cesarean section in patients with PIHS.

Conflict of Interest

The authors have no conflicts of interest to declare.

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