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Original Article

Comparison of Effects of N2O and Remifentanil on Hemodynamics of Female Patients under General Anesthesia in Motahari Hospital of Jahrom

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Abstract

Background: Remifentanil is a new short-acting opiate that is metabolized by esterase in the blood and tissues. N_2O is an anesthetic gas commonly used in general anesthetics.

Aim: The aim of this project is to compare the effects of N_2O and remifentanil on hemodynamics of patients under general anesthesia.

Materials & Methods: This is a randomized clinical trial study that was conducted on two groups of 32 women undergoing general anesthetic surgery. Before the anesthesia, blood pressure and heart rate were measured. The induction of anesthesia was similar in both groups. Continuation of anesthesia in the experimental group was with 100% oxygen (controlled ventilation), isoflurane (1MAC), injection of remifentanil (0.25 mic/kg/min), while it was with 50% oxygen+50% N_2O and isoflurane (1MAC) in the control group. Systolic and diastolic blood pressures (mm Hg) and heart rate were measured every 15 minutes during anesthesia and every 10 minutes during recovery. Data were analyzed using SPSS version 16.

Results: The mean age of the women in the first group was 36.8, and the mean age in the second group was 37.9. There was no significant difference between the groups in terms of demographic and background information such as age, which was the same in both groups. ANOVA showed a significant relationship between mean systolic and diastolic blood pressure in all time intervals in the experimental and control groups ($P<0.05$).

Conclusion: Findings suggest that remifentanil appears to cause less hemodynamic changes. Since it does not have the side effects associated with nitrous oxide, it can replace nitrous oxide in general anesthesia.

Key words: Hemodynamic, Remifentanil, Nitrous oxide

INTRODUCTION

N_2O gas is an anesthetic drug commonly used in general anesthesia. It has several complications that can occur acutely (in patients during general anesthesia and recovery), as well as in chronic complications due to long-term exposure of the operating room personnel to very low levels of N_2O due to air contamination of the operating room with the gas. Remifentanil is a strong, short-acting drug of the analgesic opioid group, which both relieves pain and causes anesthesia. Remifentanil is administered as a hydrochloride intravenous injection [1]. Animal studies have concluded that inhaling N_2O specifically increases the concentration of androgens in the CSF in the third ventricle. The results of these studies suggest the possibility of a selective opioid-containing N_2O reaction. N_2O has no effect on arterial blood pressure, pulse rate, cardiac output, as well as pulmonary and systemic vascular resistance, and is less likely to lower blood pressure than other inhaled anesthetics [2]. According to the studies, N_2O does not have much effect on hemodynamics; however, it causes significant complications such as nausea and vomiting, which can lead to problems such as disability and suffering, delay in discharge, readmission of outpatients, pulmonary complications due to aspiration, dehydration and metabolic disorders. On the other hand, remifentananil has less

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hemodynamics effect than its counterparts, and, also, it does not have the same complications as N_2O [3]. Sustained hemodynamics refers to the dynamic interaction between heart and blood flow. Effective cardiovascular system leads to the provision of cardiac outflow and arterial pressure sufficient for organ [4]. Cardiovascular system supplies blood to all organs of the body by maintaining adequate pressure in physiological (exercise-rest) and pathologic (diseases) conditions. Cardiac dysfunction and arterial dysfunction may result in a lack of compensation for acute hemodynamics and shock [5]. At rest, systolic blood pressure (or maximum blood pressure) is between 100 and 140 mmHg and normal diastolic blood pressure (or minimum blood pressure) is between 60 and 90 mmHg [6]. Therefore, the aim of this study was to compare the effect of N_2O and remifentanil on hemodynamics of patients under anesthesia.

MATERIALS AND METHOD

This clinical trial was approved by Research Deputy of Jahrom University of Medical Sciences and confirmed by the Ethics Committee of the University and conducted on a total of 64 female patients who underwent surgery in 2012-2013. Before starting the study, the design of the clinical trial was explained for each individual patient, and consents were obtained. In case of any problems during surgery such as bleeding, respiratory or cardiac problems, and dissatisfaction with the continuation of cooperation, they were excluded from the study. Women aged 20-60 years were included in the ASA 1.2 class. Patients were randomly divided into two groups of control (32 patients) and experimental (32 patients). Patients with hypertension, diabetes, asthma and heart problems, and those who did not consent to the study were excluded. All patients received general anesthesia, and the duration of surgery was more than 1 hour. In both groups, blood pressure and heart rate were measured and recorded before anesthesia. Then, for all patients, anesthesia induction was performed with thiopental sodium (4-6 mg/kg), midazolam (0.01-0.02 mg/kg), and Morphine (0.1-0.2mg/kg), Atracurium (0.4-0.6 mg/kg). Continued anesthesia in the experimental group was performed with 100% oxygen (controlled ventilation), isoflurane (1MAC), remifentanyl injection (0.25 mic/kg/min), while it was with 50% oxygen+50% N_2O and isoflurane (1MAC) in the control group. In both groups during general anesthesia, atracurium (muscle relaxant) was repeated at 25% of the initial dose in one hour after the onset of anesthesia. At the end of surgery, inhaled anesthetics were discontinued, and prostaglandin (0.04 mg/kg) and atropine (90.02 mg/kg) were injected. During anesthesia, systolic and diastolic blood pressure (mm Hg) and heart rate were measured every 15 minutes. They were measured every 10 minutes during recovery. The data was recorded along with the patients' information in the questionnaire. The data were recorded using SPSS 16, and ANOVA and T-test were used to compare the hemodynamic status of the studied groups.

RESULTS

This clinical trial study was performed on 64 women undergoing general anesthesia. The mean age of women in the first group was 36.8, and the mean age in the second group was 37.9. There was no significant difference between the groups in terms of demographic and background information such as age, which was the same in both groups.

Comparison of Effects of Nitrous Oxide and Remifentanil on Systolic Blood Pressure

The mean systolic blood pressure before anesthesia was 135±20.1 in the first (experimental) group. The mean systolic blood pressure before the start of anesthesia was 139±31.8 in the second group. They were not statistically significant (P> 0.05).

The mean diastolic blood pressure before and after anesthesia was 81.6±17.9 and 83±16, respectively. They were not statistically significant (P>0.05).

The mean systolic blood pressure in the experimental group (remifentanil) was 137±21.17 during 15-minute interval during the surgery. The mean systolic blood pressure in group 2 (nitrous oxide) during this time interval was 134±27.5.

The mean systolic blood pressure in the experimental group (remifentanil) was 138±20 during 30-minute interval during the surgery. The mean systolic blood pressure in group 2 (nitrous oxide) during this time interval was 129±25.4.

The mean systolic blood pressure in the experimental group (remifentanil) was 127±26 during 45-minute interval during the surgery. The mean systolic blood pressure in group 2 (nitrous oxide) during this time interval was 120±22.

The mean systolic blood pressure in the experimental group (remifentanil) was 130±25.2 during 1-hour interval during the surgery. The mean systolic blood pressure in group 2 (nitrous oxide) during this time interval was 119±17.7.

The mean systolic blood pressure in the experimental group (remifentanil) when entering the recovery was 125±18.3. The mean systolic blood pressure in group 2 (nitrous oxide) during this time interval was 118±18.5.

The mean systolic blood pressure in the experimental group (remifentanil) was 127±19 during 10-minute interval during recovery. The mean systolic blood pressure in group 2 (nitrous oxide) during this time interval was 111±17.

The mean systolic blood pressure in the experimental group (remifentanil) was 125±18.3 during 20-minute interval during recovery. The mean systolic blood pressure in group 2 (nitrous oxide) during this time interval was 114±14.7.

ANOVA test showed a significant relationship between mean systolic blood pressure in all time intervals in the experimental and control groups ($P<0.05$).

Comparison of Effects of Nitrous Oxide and Remifentanil on Diastolic Blood Pressure

The mean diastolic blood pressure before anesthesia was 81.6±17.9 in the first (experimental) group. The mean diastolic blood pressure before the start of anesthesia was 83±16 in the second group (Tables 1 and 2).

The mean systolic blood pressure in the experimental group (remifentanil) was 79.6±16 during first 15-minute interval of surgery. The mean diastolic blood pressure in group 2 (nitrous oxide) during this time interval was 85±17.6.

The mean diastolic blood pressure in the experimental group (remifentanil) was 82.6±14.6 during the first 30-minute of surgery. The mean diastolic blood pressure in group 2 (nitrous oxide) during this time interval was 77.7±13.1.

The mean diastolic blood pressure in the experimental group (remifentanil) was 76.2±14.3 during the first 45-minute of surgery. The mean diastolic blood pressure in group 2 (nitrous oxide) during this time interval was 75.3±13.8.

The mean diastolic blood pressure in the experimental group (remifentanil) was 74.6±16.7 during the first 1-hour of surgery. The mean diastolic blood pressure in group 2 (nitrous oxide) during this time interval was 72.3±11.7.

The mean diastolic blood pressure in the experimental group (remifentanil) when entering recovery was 73.8±11.6. The mean diastolic blood pressure in group 2 (nitrous oxide) during this time interval was 73.8±10.

The mean diastolic blood pressure in the experimental group (remifentanil) was 75.3±13.3 during the first 10-minute of recovery. The mean diastolic blood pressure in group 2 (nitrous oxide) during this time interval was 71.8±9.3.

The mean diastolic blood pressure in the experimental group (remifentanil) was 77.4±11.8 during 2 the first 20-minute of recovery. The mean diastolic blood pressure in group 2 (nitrous oxide) during this time interval was 70±9.8.

Comparison of Effects of Nitrous Oxide and Remifentanil on Heart Rate

The mean heart rate before anesthesia in group 1 (remifentanil) was 99.7. It was 93.6 in group 2 (nitrous oxide).

The mean heart rate in the first 15 minutes after the induction of anesthesia in group 1 (remifentanil) was 99.7. It was 93.6 in group 2 (nitrous oxide).

The mean heart rate in the first 30 minutes after the induction of anesthesia in group 1 (remifentanil) was 102. It was 86 in group 2 (nitrous oxide).

The mean heart rate in the first 45 minutes after the induction of anesthesia in group 1 (remifentanil) was 101. It was 86 in group 2 (nitrous oxide).

The mean heart rate in the first 1 hour after the induction of anesthesia in group 1 (remifentanil) was 95. It was 84 in group 2 (nitrous oxide).

The mean heart rate in the start of recovery in group 1 (remifentanil) was 97. It was 83 in group 2 (nitrous oxide).

Table 1: Mean systolic and diastolic blood pressure measured at different times

	Before anesthesia		15 minutes		30 minutes		45 minutes		1 hour		Start of recovery		First 10 minutes		First 20 minutes	
S	135	139	137	134	138	129	127	120	130	119	125	118	127	111	125	114
D	81	83	79	85	82	77	76	75	74	72	73	73	75	71	70	77

Table 2: Mean heart rate in two groups

Hear rate	Before anesthesia	15 minutes	30 minutes	45 minutes	1 hour	Start of recovery	First 10 minutes	First 20 minutes
Group 1	99	104	102	101	95	97	97	99
Group 2	93	93	86	86	84	83	84	86

The mean heart rate in the first 10 minute of recovery in group 1 (remifentanil) was 97. It was 84 in group 2 (nitrous oxide).

The mean heart rate in the first 20 minute of recovery in group 1 (remifentanil) was 99. It was 86 in group 2 (nitrous oxide).

DISCUSSION

This study aimed to compare the hemodynamic changes in female patients under general anesthesia. In this study, patients were divided into 2 groups. The experimental group received remifentanil, while the control group received nitrous oxide.

In general, total intravenous anesthesia has many disadvantages and advantages over inhalation anesthesia. One of the most important advantages is the possibility of faster anesthetic deepening than evaporative anesthetics for surgery, faster recovery, lack of air pollution in the operating room, no cardiodepression caused by evaporation drugs, and decreased systolic blood pressure and cardiac output. According to the findings of this study, the baseline values of systolic, diastolic, and mean arterial pressure, as well as the heart rate, were similar in both groups and did not differ significantly. After induction of anesthesia at intervals of 15, 30, 45 and 60 minutes, and in the recovery period, at the beginning of recovery, 10 and 20 minutes, all three factors of systolic and diastolic blood pressure and hemodynamic variables decreased. Findings were analyzed using one-way variance test. It was concluded that the mean systolic pressure drop was more pronounced in group 2 after 30 minutes of anesthesia induction.However, this pressure drop did not affect the patients' health. The changes in the average diastolic pressure were also more evident after 30 minutes. The heart rate of patients in group 2 who received nitrous oxide also decreased significantly. The findings of this study are consistent with the study by Eidi, which shows that nitrous oxide has a greater effect on hemodynamics than remifentanil [7]. On the other hand, patients receiving remifentanil were less likely to experience nausea and vomiting.Our patients had similar conditions in terms of duration of surgery, operating room conditions, gender, age, and other factors affecting hemodynamic response, and no significant difference was found. In this study, mean heart rate was significantly different in both groups ($P<0.05$), so that the mean heart rate was higher in the first group, which received remifentanil. Remifentanil appears to cause less hemodynamic changes compared to other fentanyl drugs [8], resulting in more efficient analgesia, more stable hemodynamics, and satisfaction of the surgeon, as well as faster recovery. In this regard, Akhavan et al. reported similar results [9]. The hemodynamic conditions of patients (blood pressure and heart rate) are suitable factors for measuring the level of anesthesia. A study that compared sevoflurane and nitrous oxide with propofol and remifentanil reported results similar to our study [10]. According to the studies, N2O does not have a considerable effect on hemodynamics; however, it causes significant complications such as nausea and vomiting, which can lead to problems such as disability, patient discomfort, delay in discharge, need for readmission in outpatients, pulmonary complications caused by aspiration, dehydration and metabolic disorders. Studies by Grandmann et al. (2008) suggested such complications. According to the findings of this study, nitrous oxide lowered blood pressure and heart rate as compared to remifentanil. The baseline values of systolic, diastolic, and mean arterial pressure and heart rate were similar in both groups and did not differ significantly. The decrease in systolic and diastolic blood pressure and heart rate in group 2 who received nitrous oxide was higher than that of the remifentanil group (group 1). Remifentanil seems to cause less hemodynamic changes, and since it does not have the side effects of nitrous oxide, it can replace nitrous oxide in general anesthesia.

CONCLUSION

Given that remifentanil does not cause the complications mentioned for nitrous oxide, it can be used to maintain hemodynamic status in general anesthesia.

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