Comparison in anesthetic effects of propofol among patients with different ABO blood groups

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Abstract

Our study was aimed to investigate anesthetic effects of propofol in patients with different blood groups. A total of 72 participants were enrolled from patients arranged for surgeries of cholecystectomy, tonsillectomy, and spinal operation. Each blood group (A, B, AB, and O) contained 18 participants. Mean arterial pressure (MAP), heart rate (HR), and bispectral index (BIS) were assayed with Philips monitor. These indexes were observed before propofol anesthesia \( T_0 \), and then were recorded when concentration of propofol was 1 \( \mu \)g/mL \( T_1 \), 2 \( \mu \)g/mL \( T_2 \), 3 \( \mu \)g/mL \( T_3 \), and 4 \( \mu \)g/mL \( T_4 \). The differences in MAP, HR, and BIS at \( T_0 \) among groups were compared with the \( \chi^2 \) test. Multiple comparisons were adopted to calculate the differences in MAP, HR, and BIS between groups at \( T_1 \), \( T_2 \), \( T_3 \), and \( T_4 \).

No significant differences in age, sex, and weight of all groups were found \( (P > .05) \). Before propofol anesthesia \( (T_0) \), all the participants exhibited no differences in MAP, HR, and BIS \( (P > .05) \). Subsequently, we found obvious differences in \( \Delta \)MAP, \( \Delta HR \), and \( \Delta BIS \) between groups. The patients in the B blood group showed highest \( \Delta MAP \) and \( \Delta HR \) at each time point \( (P < .05 \) for both). As for \( \Delta BIS \), patients in A blood group exhibited highest value at \( T_3 \) and \( T_4 \) \( (P < .05) \).

The blood group remarkably affects the anesthetic effects of propofol.

Abbreviations: BIS = bispectral index, HR = heart rate, IR = ischemia-reperfusion, MAP = mean arterial pressure, RSE = refractory status epilepticus, VWF = Von Willebrand factor.

Keywords: anesthesia, blood group, propofol

1. Introduction

Propofol, 2, 6-disopropylphenolph, is the most popular intravenous anesthetic drug.\(^{[1]}\) It has many advantages over other anesthetic drugs: rapid onset, short duration, few side effects, and prompt recovery.\(^{[2]}\) The sedative efficacy of propofol for children has been confirmed in clinical trials since the 1990s.\(^{[3-5]}\) However, most patients experience unpleasant pain at its injection site. Apart from anesthesia effects, many articles reported the nonanesthetic roles of propofol, such as antiemetic effects, anxiolytic effects, immunomodulatory activity, and analgesia.\(^{[6,7]}\) Meanwhile, propofol and thiopental sodium are used in various surgeries.\(^{[8,9]}\) Until now, propofol, as an anesthetic agent, is widely used among patients with different ABO blood groups.

In the study of Hari Keerthy et al,\(^{[10]}\) propofol behaved better than midazolam in minor oral surgery for fast recovery and onset of action. Chen et al\(^{[11]}\) reported that propofol used for the maintenance of general anesthesia greatly reduced the incidence of postoperative nausea and vomiting and improved the postoperative patient well-being. Moreover, it resulted in obvious cost reductions. After the hernia surgery of children, propofol could impair short-term memory postoperatively, compared to sevolulurane.\(^{[12]}\) For the patients undergoing donor hepatectomy, propofol exerted protective effects against ischemia-reperfusion (IR) injury.\(^{[13]}\)

According to previous studies, the efficacy of propofol is affected by many factors. Obesity is potentially associated with the pharmacokinetic and pharmacodynamic profile of anesthetic drugs.\(^{[14]}\) The study of Olutoye et al\(^{[15]}\) suggested that obese children require lower dose of propofol for induction of anesthesia than normal-weight children. Meanwhile, elderly patients might need lower doses of propofol for procedural sedation in the Emergency Department, compared with younger adults.\(^{[16]}\) Choong et al\(^{[17]}\) concluded that more rapid propofol metabolism may occur in women than men. However, no research investigated the influence of ABO blood group on the efficacy of propofol.

The patients with different blood group arranged for surgeries were enrolled in the present research. Propofol was used as an anesthetic agent and the changes of mean arterial pressure (MAP), heart rate (HR), and bispectral index (BIS) indexes represented the influences of ABO blood group on efficacy of propofol.

2. Method

2.1. Patients’ enrollment

The study was approved by ethics committee of The Affiliated Hospital of Inner Mongolia Medical University. Written
informed consent was obtained from each patient. The participants were enrolled from patients arranged for surgeries of cholecystectomy, tonsillectomy, and spinal operation. The participants were required without cardiovascular and endocrine metabolic diseases. A total of 72 participants were enrolled. Each blood group (A, B, AB, O) contained 18 participants.

2.2. Anesthesia performance

Venous access was established on all the participants and no medicine was provided before anesthesia. MAP, HR, and BIS were determined before propofol anesthesia. Rocuronium bromide was used to keep muscle relaxation.

2.3. Statistics

The differences in MAP, HR, and BIS at T0 were compared with the χ² test. The same analysis was performed in age, sex, and weight. Multiple comparison was adopted to calculate the differences in MAP, HR, and BIS between group at T1, T2, T3, and T4. P < .05 indicates significant differences. The analysis was conducted in the SPSS 18.0 software.

3. Results

3.1. Baseline characteristics of participants

As shown in Table 1, there were no obvious differences in age, sex, and weight of all groups (P > .05). Meanwhile, MAP, HR, and BIS values at T0 point were analyzed. Before propofol anesthesia, all the participants showed no differences in MAP, HR, and BIS (P > .05).

3.2. MAP, HR, and BIS changes of each group

Multiple comparisons of MAP, HR, and BIS indexes between groups were performed. The results were exhibited in Table 2. No significant differences of MAP, HR, and BIS values at each time point between groups were found. However, we observed differences in ΔMAP, ΔHR, and ΔBIS between groups. The patients in the B blood group showed highest ΔMAP at each time point (P < .05). Similar result was observed in ΔHR (P < .05). As for ΔBIS, patients in A blood group exhibited highest value at T3 and T4 (P < .05).

4. Discussion

MAP, HR, and BIS are important indexes representing the efficacy of anesthesia. MAP represents the hemodynamic responses. Decrease in arterial blood pressure is a main adverse reaction during propofol sedation. Erdman et al. found severe hypotension and bradycardia occurred in neurocritical care patients received dexmedetomidine or propofol, which was also observed by Yokoe et al. BIS is valuable in guiding the administration of propofol intraoperatively.

| Table 1 |
|---|
| **Baseline characteristics of participants.** |
| **Index** | **A** | **B** | **AB** | **O** | **P** |
| Age, y | 52.11 ± 7.67 | 51.17 ± 5.68 | 48.44 ± 6.64 | 51.89 ± 4.87 | .579 |
| Sex, female/male | 10/8 | 10/8 | 9/9 | 9/9 | .893 |
| Weight, kg | 62.38 ± 6.95 | 60.44 ± 5.50 | 61.50 ± 6.20 | 60.78 ± 6.90 | .808 |
| MAP, mm Hg, T0 | 93.50 ± 6.61 | 93.11 ± 6.95 | 93.38 ± 6.68 | 96.06 ± 9.07 | .604 |
| HR, beats min⁻¹, T0 | 82.50 ± 4.59 | 86.06 ± 3.83 | 84.11 ± 4.30 | 85.56 ± 5.47 | .097 |
| BIS, T0 | 94.78 ± 7.88 | 95.94 ± 8.03 | 97.06 ± 8.05 | 96.56 ± 6.66 | .829 |

BIS = bispectral index, HR = heart rate, MAP = mean arterial pressure.

| Table 2 |
|---|
| **Comparison of MAP, HR, and BIS between groups.** |
| **Index** | **Group** | **T1** | **T2** | **T3** | **T4** |
| ΔMAP, mm Hg | A | 14.72 ± 3.94 | 18.89 ± 5.97 | 18.67 ± 4.00 | 26.06 ± 3.89 |
| | B | 19.06 ± 5.76 | 23.06 ± 4.90 | 24.06 ± 4.90 | 32.17 ± 5.62 |
| | AB | 14.89 ± 3.08 | 19.50 ± 3.76 | 19.72 ± 2.63 | 24.11 ± 5.95 |
| | O | 15.78 ± 2.53 | 19.94 ± 2.71 | 21.11 ± 2.68 | 25.28 ± 19.94 |
| ΔHR, beats min⁻¹ | A | 6.39 ± 3.33 | 9.72 ± 3.66 | 12.50 ± 4.11 | 12.39 ± 4.84 |
| | B | 12.56 ± 4.13 | 16.06 ± 4.70 | 18.39 ± 5.41 | 18.50 ± 5.25 |
| | AB | 6.17 ± 1.72 | 9.00 ± 3.69 | 11.50 ± 5.36 | 12.83 ± 3.88 |
| | O | 7.06 ± 1.95 | 11.33 ± 5.44 | 12.83 ± 2.46 | 13.33 ± 2.79 |
| ΔBIS | A | 21.11 ± 5.10 | 35.11 ± 5.77 | 46.00 ± 5.80 | 51.06 ± 5.78 |
| | B | 22.29 ± 5.70 | 35.00 ± 4.72 | 40.11 ± 6.49 | 44.06 ± 5.80 |
| | AB | 22.50 ± 5.34 | 34.61 ± 5.17 | 39.89 ± 6.04 | 44.72 ± 6.46 |
| | O | 21.06 ± 5.78 | 33.94 ± 5.97 | 41.11 ± 5.77 | 43.61 ± 6.24 |

BIS = bispectral index, HR = heart rate, MAP = mean arterial pressure.

*P < .05 compared to other 3 groups.
BIS level is observed in the anesthesia treatments of propofol and sevoflurane.[24] In our research, changes of MAP, HR, and BIS were also used to figure out the influences of ABO blood group.

The results indicated that the patients in the B blood group showed highest ΔMAP at T1, T2, T3, and T4. Meanwhile, the B blood group also exhibited highest ΔHR at each time point. In terms of ΔBIS, patients of A blood group showed highest value at T3 and T4. Above mentioned results indicated that the ABO blood group might exert strong effects on anesthetic efficacy of propofol.

However, the function mechanism of blood group in regulating the efficacy of propofol is unclear. As we all know, decreased blood flow velocity, hypercoagulable blood, and injured vessel wall usually occurred during anesthesia performance in surgeries. Moreover, the patients with different ABO blood groups exhibited significantly different levels of Von Willebrand factor (VWF). The patients of O blood group had obviously lower content of VWF than the non-O blood group, which was directly related with incidence of thrombosis.[25–28] VWF is an adhesive glycoprotein synthesized by megakaryocytes and endothelial cells.[29,30] It shows crucial roles in primary hemostasis and, moreover, has a pivotal role in thrombogenesis.[31] It has been demonstrated that the increased level of VWF is an important risk factor of thrombosis.[32,33] In vitro experiment suggested that removal of A and B antigens from purified plasma decreased VWF activity.[34] Moeller et al.[35] thought that ABO antigens in vivo affected synthesis rate or proteolysis of VWF molecule rather than its structure and function. Meanwhile, many studies have demonstrated a tight correlation between the ABO blood group and hemostasis. The patients of group O are more likely to suffer bleeding complications.[36] Moreover, a number of studies reported the increased risk of venous thromboembolism in non-O individuals.[37,38] All the above-mentioned information suggests that ABO blood group might involve in the pharmacokinetic and pharmacodynamics, which was demonstrated in our study.

However, there existed deficits in our study. The specifically regulatory mechanism of ABO blood group on pharmacodynamics of propofol was not studied, which helps in understanding individual difference in response to propofol anesthesia. In addition, the sample size was relatively small. The broad-range investigation contributes to more accurate and reliable results. In conclusion, the ABO blood group was related with the efficacy of propofol. Patients of B blood group showed highest ΔMAP and ΔHR at each time point. Patients of A blood group exhibited highest value of ΔBIS at T3 and T4.

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