Am J Transl Res 2024;16(8):3787-3793
www.ajtr.org /ISSN:1943-8141/AJTR0156597

Original Article

Effectiveness of propofol in anesthetic management and cognitive function in schizophrenic patients undergoing convulsion-free modified electroconvulsive therapy

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Received March 15, 2024; Accepted June 20, 2024; Epub August 15, 2024; Published August 30, 2024

Abstract: Objective: To investigate the effects of propofol on anesthetic effectiveness and cognitive functioning in schizophrenic patients undergoing convulsion-free modified electroconvulsive therapy (MECT). Methods: A retrospective analysis was conducted on the clinical data of 80 schizophrenia patients treated with MECT at the Affiliated Brain Hospital of Guangzhou Medical University from January 2021 to December 2023. Patients were divided into a control group (39 patients) receiving etomidate and an observation group (41 patients) receiving a combination of etomidate and propofol for general anesthesia induction. Parameters compared between the groups included systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), arterial oxygen saturation (SaO_2), time to spontaneous respiration recovery, wakefulness time, cognitive function (assessed by the Wechsler Adult Intelligence Scale-Revised in China, WAIS-RC), symptom severity (measured by the Positive and Negative Syndrome Scale, PANSS), and adverse reactions. Results: No significant differences were observed in SBP, DBP, HR, and SaO_2 between the groups over time, nor was there any interaction between group and time on these parameters (all $P>0.05$). However, the observation group showed significantly shorter times to spontaneous respiration recovery and wakefulness (both $P<0.05$). Post-treatment, the observation group also had higher WAIS-RC scores and lower PANSS scores, along with a reduced total incidence of adverse reactions (all $P<0.05$). Conclusion: Propofol for the induction of general anesthesia in MECT, enhances clinical anesthetic outcomes, diminishes the impact on cognitive functions, and reduces the incidence of adverse reactions, thereby suggesting its high safety and efficacy.

Keywords: Propofol, modified electroconvulsive therapy, schizophrenia

Introduction

Schizophrenia is a chronic mental disorder that can lead to cognitive dysfunction and decreased quality of life if not treated promptly and effectively. Pharmacotherapy is the primary treatment for schizophrenia, significantly reducing symptoms and controlling disease progression; some patients may even achieve remission with drug therapy. However, a subset of patients remains symptomatic, exhibiting poor responses to conventional treatments [1]. Modified electroconvulsive therapy (MECT) employs anesthesia to ensure that electrical stimulation is administered in a state of muscle relaxation and sedation, effectively suppressing abnormal brain activity and controlling psychiatric symptoms [2, 3]. However, MECT can cause transient increases in blood pressure, cardiac arrhythmias, and other complications such as dizziness. Consequently, enhancing anesthetic drugs to minimize these risks is a critical focus of current research [4, 5].

The selection of optimal anesthetic agents to improve clinical anesthesia outcomes is a significant challenge in surgery. Typically, etomidate or propofol are used independently for general anesthesia during MECT. While etomidate may not effectively mitigate the cardiovascular responses associated with MECT, propofol can suppress EEG seizures, potentially influencing the efficacy of MECT [6]. Despite numerous studies on the effectiveness of propofol in treating schizophrenia during MECT, research on its impact on cognitive function is relatively

https://doi.org/10.62347/OXMW8152

sparse. Therefore, this study investigates the anesthetic efficacy of propofol in MECT for schizophrenic patients, examining its effects on cognitive function and drug safety, as detailed below.

Material and methods

Study design and patients

This retrospective study assessed 300 patients initially, narrowing down to 80 who met the inclusion and exclusion criteria, based on the sample size estimation methods from Mehta et al. [7]. The study analyzed clinical data from 80 schizophrenic patients treated with MECT at the Affiliated Brain Hospital of Guangzhou Medical University between January 2021 and December 2023. Data were extracted from electronic medical records.

Inclusion criteria: (1) Diagnosis of schizophrenia according to the ICD-10 criteria for mental and behavioral disorders [8]. (2) Patients who underwent MECT at the Affiliated Brain Hospital of Guangzhou Medical University for indications such as medication refusal, body stiffness, severe self-harm, or aggressive behaviors. (3) Patients who received either etomidate or a combination of etomidate and propofol for anesthesia. (4) Availability of complete clinical data including demographic information, hemodynamic indices pre- and post-anesthesia, scores from the WAIS-RC, and the PANSS.

Exclusion criteria: (1) Presence of comorbidities affecting MECT outcomes. (2) Organic brain diseases or severe cardiac, hepatic, or systemic illnesses. (3) History of severe allergies to etomidate or propofol. (4) Incomplete anesthesia records. This study was approved by the Ethics Committee of the Affiliated Brain Hospital of Guangzhou Medical University.

Procedure and treatment protocol

All patients underwent MECT. Prior to treatment, they were instructed to fast and abstain from drinking for 8 hours. Upon entering the treatment room, an electrocardiogram (ECG) was connected, and vital signs, including blood pressure and heart rate (HR), were closely monitored. Patients were positioned supine, and 1 mg of Atropine Sulfate Injection (Henan Runhong Pharmaceutical Co., Ltd., National Medicine number H41020324, 1 mL:0.5 mg) was administered intravenously 5 minutes before treatment to facilitate natural limb extension and venous access.

In the control group, Etomidate Injectable Emulsion (Xuzhou Enhua Pharmaceutical Co., Ltd., National Medicine number H20020511, 20 mL:20 mg) was administered intravenously at a dose of 0.3 mg/kg. The observation group received an intravenous injection of 0.15 mg/kg etomidate plus 1.0 mg/kg Propofol Injection (Jiangsu Enhua Pharmaceutical Co., Ltd., National Medicine number H20123138, 20 mL:200 mg). Following the disappearance of the eyelash reflex, 1.0 mg/kg Suxamethonium Chloride Injection (Xi'an Hanfeng Pharmaceutical Co., Ltd., Approval number H20054745, 1 mL:50 mg) was administered intravenously to both groups. Treatment commenced 1.0-1.5 minutes later using the Spectrum 5000Q therapy machine (Bestune, USA). Treatment intensity was adjusted based on the patient's age, physique, and seizure responsiveness.

During the procedure, the inhalation concentration was adjusted to maintain the Bispectral Index value between 40-60, ensuring an appropriate depth of anesthesia. Treatment was administered over three weeks: three sessions in the first week, two in the second, and one in the third week.

Data collection

Clinical data were gathered from hospital electronic medical records, including patient demographics (sex, age), disease duration, schizophrenia type, and American Society of Anesthesiologists classification.

Patients were divided into a control group (n=39) and an observation group (n=41) based on the anesthesia method employed. Preliminary data comparison showed comparability between groups, detailed in **Table 1**.

Primary comparisons included hemodynamic indices, recovery and wake times, cognitive function scores, and symptom severity. The study primarily investigated the anesthetic effects of propofol in schizophrenia patients undergoing non-convulsive electroconvulsive therapy and its impact on cognitive functions.

Table 1. Comparison of general information [$\bar{x}$±sd, n (%)]

Factor	Control group (n=39)	Observation group (n=41)	χ^2/t	*P*
Gender				
Female	15 (38.46)	19 (46.34)	0.508	0.476
Male	24 (61.54)	22 (53.66)		
Age (yrs)	44.41±8.31	43.46±7.62	0.532	0.597
Course of disease (yrs)	4.72±1.23	4.66±1.11	0.227	0.821
Disease type				
Simple type	25 (64.10)	21 (51.22)	1.357	0.244
Paranoid type	14 (35.90)	20 (48.78)		
ASA grade				
I grade	24 (61.54)	23 (56.10)	0.244	0.621
II grade	15 (38.46)	18 (43.90)		

ASA: American Society of Anesthesiologists.

Outcome measures

Primary measurements included changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and arterial oxygen saturation (SaO_2) measured pre-anesthesia, 30 minutes into anesthesia, and post-MECT, using the Arekon M-9000E multi-parameter ECG monitor. Recovery times for spontaneous respiration and awakening post-MECT were also documented.

Secondary measurements included: Cognitive Function: Assessed using the WAIS-RC one day before treatment and six times post-treatment, evaluating verbal IQ, performance IQ, and total IQ. Higher scores indicate better cognitive function, with the scale demonstrating good internal consistency (Cronbach's α=0.856). Symptom Severity: The PANSS was used to evaluate symptom severity pre- and post-treatment across three domains: general psychopathology, negative symptoms, and positive symptoms. Each of the 33 items is rated from 1 to 7, with total scores ranging from 33 to 231, where higher scores signify greater symptom severity. Adverse Reactions: Incidences such as injection pain, muscle tremors, nausea, and vomiting were monitored and analyzed across both groups during treatment.

All collected data were rigorously verified to adhere to the study's standards.

Statistical analysis

Statistical analysis was performed using SPSS 23.0. Quantitative data were expressed as mean ± standard deviation (x±sd) and analyzed using independent sample t-tests for inter-group comparisons and paired t-tests for pre-post treatment comparisons. Repeated measures ANOVA was utilized for analyzing data at different time points. Categorical data were expressed as percentages (%) and analyzed using chi-square tests. A *p*-value of less than 0.05 was considered statistically significant.

Results

Comparison of perioperative vital signs

Repeated measures ANOVA indicated no significant intergroup differences in SBP, DBP, HR, and SaO_2 (F=1.122, P=0.293; F=1.710, P=0.195; F=3.590, P=0.062; F=0.084, P=0.773, respectively). However, SBP, DBP, HR, and SaO_2 increased over time in both groups (time effect: F=4.461, P=0.013; F=5.850, P=0.004; F=61.018, P<0.001; F=4.894, P=0.009). No interaction effects between group and time were observed (interaction effect: F=0.011, P=0.989; F=0.308, P=0.736; F=0.191, P=0.826; F=1.609, P=0.203) (**Figure 1**).

Comparison of anesthesia index

The observation group experienced shorter times for recovery of spontaneous respiration and awakening compared to the control group (both P<0.05) (**Table 2**).

Comparison of cognitive function

Initially, no significant differences were observed in verbal IQ, performance IQ, or total IQ

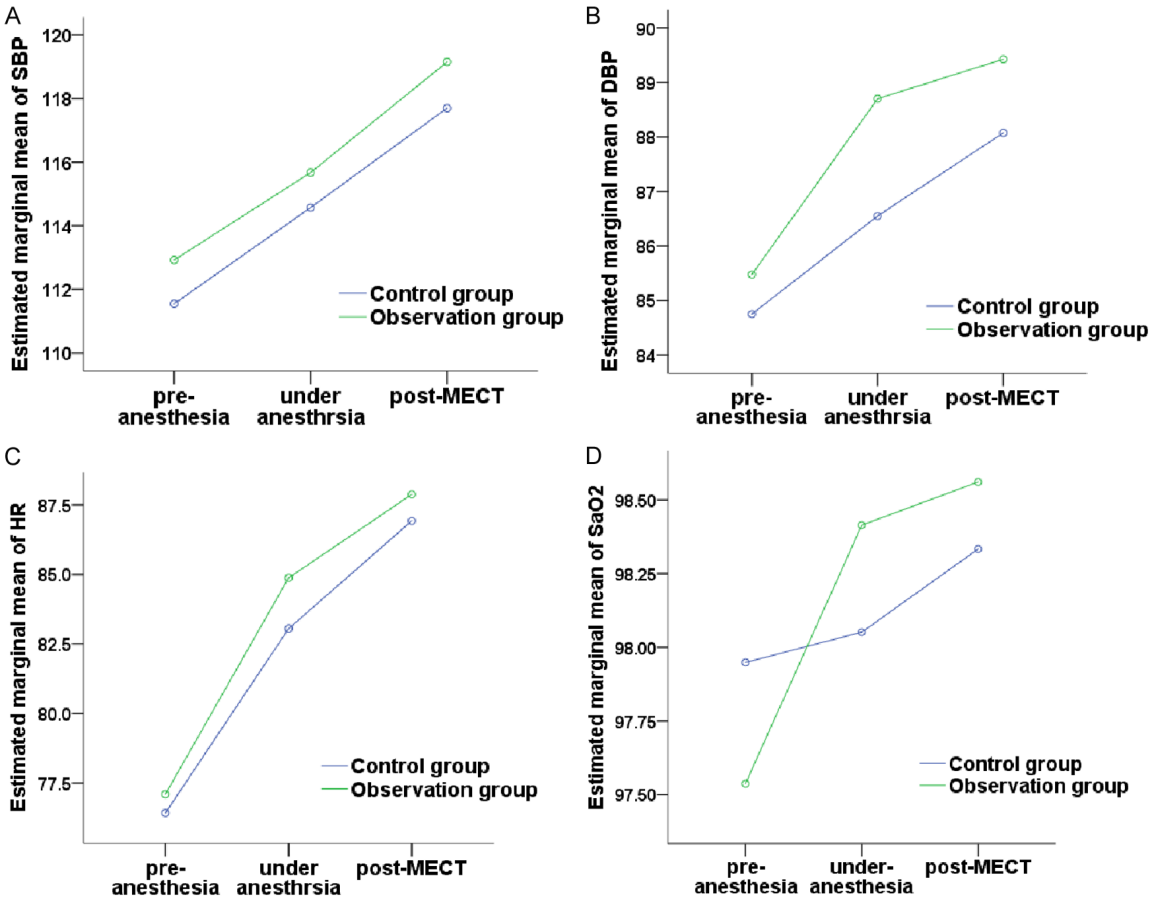

Figure 1. Comparison of vital signs. Note: A: Systolic blood pressure (SBP); B: Diastolic blood pressure (DBP); C: Heart rate (HR); D: Arterial oxygen saturation (SaO_2).

Table 2. Comparison of anesthesia indexes ($\bar{x}\pm sd$)

Group	Recovery time for spontaneous breathing (min)	Recovery time (min)
Control group (n=39)	10.51±2.11	18.18±2.87
Observation group (n=41)	7.27±1.79	14.37±2.52
t	7.427	6.332
P	<0.001	<0.001

scores between the two groups (all P>0.05). Post-treatment, all cognitive function scores improved, with more significant improvements noted in the observation group (all P<0.05) (**Figure 2**).

Comparison of symptom severity

Baseline PANSS scores did not differ significantly between the groups (P>0.05). Post-treatment scores decreased in both groups, with the observation group showing a more significant reduction compared to the control group (P<0.001) (**Figure 3**).

Comparison of adverse reactions

The incidence of adverse reactions was significantly lower in the observation group at 7.32%, compared to 28.21% in the control group (P<0.05) (**Table 3**).

Discussion

Schizophrenia is a prevalent psychiatric disorder characterized by chronicity, recurrent episodes, and potential cognitive decline, significantly impacting quality of life [9]. Historically, antipsychotic drugs have been the primary treatment for schizophrenia; however, some patients experience limited relief from these

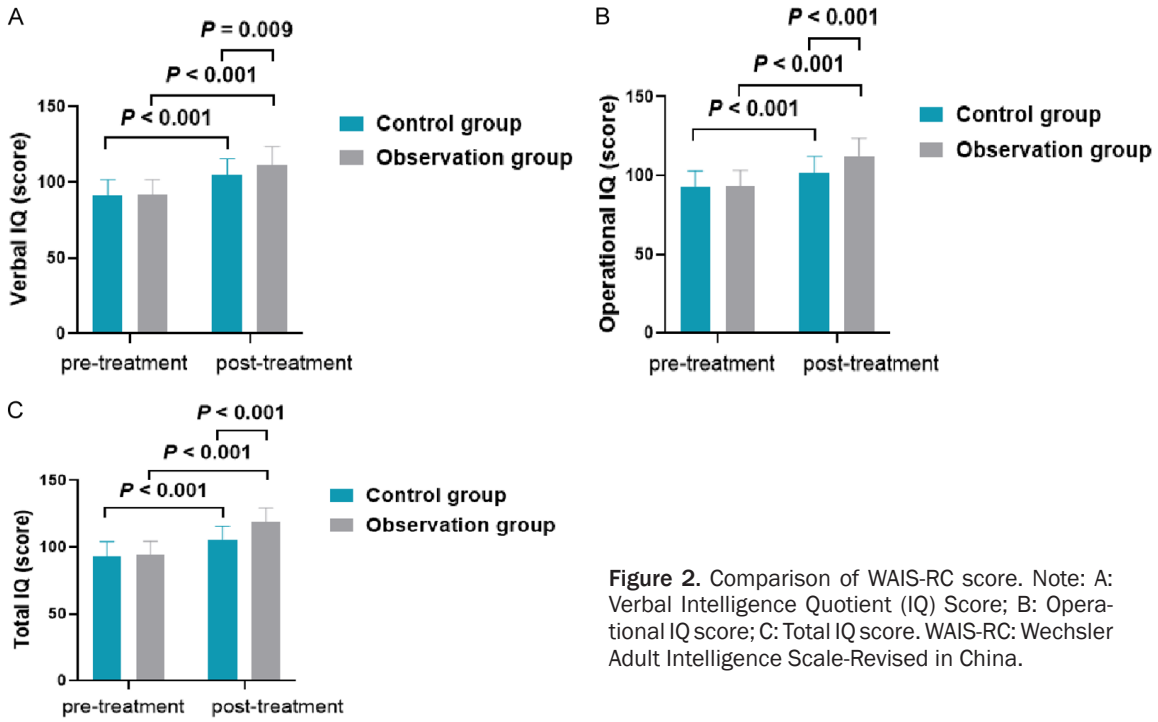

Figure 2. Comparison of WAIS-RC score. Note: A: Verbal Intelligence Quotient (IQ) Score; B: Operational IQ score; C: Total IQ score. WAIS-RC: Wechsler Adult Intelligence Scale-Revised in China.

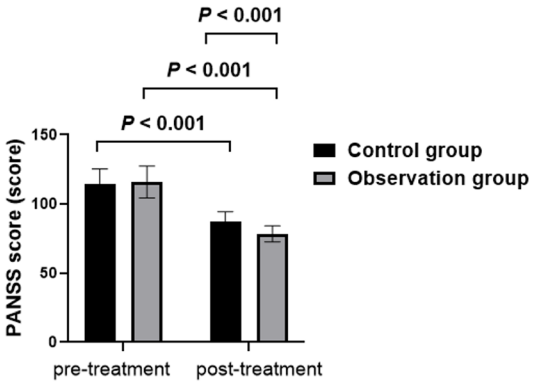

Figure 3. Comparison of PANSS score. Note: PANSS: Positive and negative syndrome scale.

medications [10]. MECT is an effective physical therapy in clinical psychiatry, used to treat mental illnesses such as schizophrenia and depression [11]. Nevertheless, MECT can induce transient systemic sympathetic excitation due to electrical stimulation, releasing a surge of catecholamines that may cause tachycardia and elevated blood pressure [12]. Therefore, selecting appropriate anesthetic drugs is crucial for managing these effects in schizophrenic patients undergoing MECT.

Propofol, a short-acting alkyl phenol anesthetic, is known for its potent sedative properties, short half-life, rapid distribution, and primarily hepatic metabolism. It limits circulatory impact to an extent while achieving sedation by inhibiting the central nervous system's excitatory transmission. Research indicates that propofol allows patients to enter a sleep state within 40 seconds post-injection, facilitating rapid onset and ease of awakening, potentially linked to the low expression of neuron-specific enolase [13]. However, propofol may inhibit EEG activity related to seizures, potentially impacting the clinical efficacy of MECT.

The study data indicated that post-MECT treatment, there were increases in SBP, DBP, and HR across both patient groups, though these changes were not statistically significant. These findings suggest that propofol effectively inhibits the cardiovascular response elicited by MECT and stabilizes circulatory function in patients, aligning with the observations made by Jin et al. [14]. The data further endorse the use of propofol in elderly patients, highlighting its safety, efficacy, and minimal impact on hemodynamics.

Additionally, the observation group exhibited shorter recovery times for spontaneous breathing and awakening compared to the control group. These outcomes are consistent with

Table 3. Comparison of adverse reactions

Group	Injection pain	Muscle tremor	Nausea and vomiting	Total incidence (%)
Control group (n=39)	5 (12.82)	3 (7.69)	3 (7.69)	11 (28.21)
Observation group (n=41)	2 (4.88)	1 (2.44)	0 (0.00)	3 (7.32)
χ^2	0.741	0.319	1.492	6.040
P	0.389	0.572	0.222	0.014

Zhang's findings [15], which suggest that adding propofol to etomidate enhances the recovery process, particularly in terms of awakening and the resumption of voluntary respiration. Post-treatment improvements were noted in cognitive domains such as memory and attention in schizophrenia patients. However, anesthetics, including propofol and etomidate, can impact cognitive function. Li et al. [16] reported that concurrent anesthesia with these drugs was effective in mitigating cognitive decline in these patients. The present study's data confirmed that treated patients showed enhanced cognitive functioning scores compared to the control group.

Furthermore, the occurrence of adverse reactions due to anesthesia in MECT warrants significant clinical attention. Our findings revealed a higher incidence of adverse reactions in the control group compared to the observation group, corroborating Liu's study [17]. This underscores the importance of selecting anesthetic drugs that not only optimize MECT outcomes but also enhance patient comfort and safety.

However, the study's limitations, including its retrospective nature and small sample size, necessitate further research with more diverse and larger samples to validate these findings.

In conclusion, propofol use in MECT for general anesthesia induction in schizophrenia patients effectively maintains vital sign stability, mitigates stress responses, reduces anesthesia-related risks, and lowers the occurrence of adverse reactions, thereby confirming its safety.

Disclosure of conflict of interest

None.

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