Journal of Clinical and Nursing Research, 2024, Volume 8, Issue 9
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Effects of Dezocine and Propofol Combination on Plasma 5-HT and ET Levels in Stroke Patients Undergoing Thrombolysis

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Abstract: *Objective:* To investigate the effect of dezocine combined with propofol on brain metabolism in patients undergoing cerebral thrombosis thrombolysis. *Methods:* A total of 86 stroke patients admitted between July 2022 and December 2023 were randomly divided into two groups: Group A (study group) and Group B (control group), with 43 patients in each group. Both groups underwent intra-arterial thrombolysis therapy. Group B received dezocine for anesthesia, while Group A received a combination of dezocine and propofol. Plasma concentrations of 5-hydroxytryptamine and endothelin, as well as brain metabolic indicators, were compared between the two groups immediately after anesthesia, at 1 hour post-reperfusion, and 3 hours post-reperfusion. *Results:* There were no significant differences in the levels of 5-hydroxytryptamine and endothelin between the two groups immediately after anesthesia and at 1 hour post-reperfusion ($P > 0.05$). However, at 3 hours post-reperfusion, the levels of 5-hydroxytryptamine and endothelin in Group A were significantly lower than those in Group B. Furthermore, in Group A, the levels of 5-hydroxytryptamine and endothelin at 3 hours post-reperfusion were lower compared to the levels at 1 hour post-reperfusion ($P < 0.05$). *Conclusion:* Dezocine combined with propofol can effectively improve the quality of anesthesia and has a minimal effect on brain metabolic indices, suggesting reduced damage to brain metabolism.

Keywords: Dezocine; Propofol; 5-Hydroxytryptamine; Endothelin; Cerebral apoplexy

Online publication: September 26, 2024

1. Introduction

Stroke, also known as cerebral apoplexy, is caused by the narrowing or occlusion of the arteries supplying blood to the brain or by an inadequate blood supply to the brain. This condition can lead to ischemia, hypoxia, and even necrosis of brain tissue, posing a serious threat to the life and health of patients [1]. In elderly patients, due to the gradual decline in metabolic function, the dramatic changes in hemodynamics and stress response during surgery can have a more significant impact on brain blood supply. After surgery, these patients may be at increased risk of cognitive impairment, making the choice of an appropriate anesthetic regimen crucial.

Currently, several anesthesia methods are commonly used for stroke surgery, including propofol combined with opioids, propofol combined with nitrous oxide, arachnoid block, and local anesthesia [2,3]. Among these methods, propofol combined with opioids is the most widely used. Dezocine is a potent opioid analgesic with excellent pharmacodynamic and pharmacokinetic properties, frequently used as an anesthetic aid or for anesthesia induction in thrombolytic procedures. As an opioid κ-receptor agonist and mu-receptor antagonist, dezocine is mainly used for postoperative analgesia and pain caused by visceral conditions or cancer. It effectively inhibits impulse transmission in the central nervous system, providing analgesic effects. Additionally, dezocine can reduce postoperative pain, alleviate the stress response induced by pain, and lower the risk of postoperative cognitive impairment [4].

This study aims to evaluate the effects of dezocine combined with propofol in elderly stroke patients. A group of elderly stroke patients were selected and randomly divided into two groups. The control group received propofol anesthesia, and their hemodynamic indicators such as heart rate and mean arterial pressure were regularly recorded. The Ramsay sedation score was also measured at various time points to assess the depth of sedation, and the cognitive function and anxiety levels of the patients were evaluated using an assessment scale [5]. In the experimental group, patients were anesthetized with a combination of dezocine and propofol. During the operation, close monitoring of physiological indicators such as heart rate, blood pressure, and respiratory rate was conducted to ensure patient safety. Additionally, the depth of sedation and cognitive function were recorded to compare and analyze the effects of different anesthesia regimens.

This study aims to gain a comprehensive understanding of the application of dezocine combined with propofol in elderly stroke patients. It was hoped that this combined analgesia method could effectively reduce the patient's stress response, stabilize hemodynamic indices, and improve cognitive function. This research will provide detailed and scientific reference data for selecting clinical anesthesia methods during stroke surgeries in elderly patients. Moreover, the study aims to offer a safer and more effective treatment plan for elderly stroke patients, ultimately improving their quality of life.

In addition, anxiety levels were also assessed. Anxiety is a common emotional response before surgery and may influence surgical outcomes and postoperative recovery. By evaluating the degree of anxiety in patients, we can better understand their psychological state and provide more comprehensive reference information for clinicians.

In conclusion, this study will evaluate the effects of dezocine combined with propofol in elderly stroke patients, analyzing the impact on hemodynamics, stress response, and cognitive function. The findings will serve as a reference for clinical decisions regarding anesthesia selection during reperfusion in elderly stroke patients.

2. Materials and methods

2.1. General information

A total of 86 stroke patients admitted to the hospital between July 2022 and December 2023 were selected for this study. They were randomly divided into two groups using a random number table method: Group A (study group) and Group B (control group), with 43 patients in each group. Group A consisted of 27 male and 16 female patients, aged 43 to 73 years, with an average age of (55.31 ± 6.47) years. Group B included 28 male and 15 female patients, aged 36 to 75 years, with an average age of (57.36 ± 6.82) years. The American Society of Anesthesiologists (ASA) classification for patients in both groups was Class II and III, respectively. There were no significant differences in the general characteristics of the two groups ($P > 0.05$), making them comparable.

2.2. Inclusion and exclusion criteria

Inclusion criteria: age ≥ 60 years; ASA grade I and II; elective hysteroscopic surgery under general anesthesia; junior high school education or above; and signed informed consent.

Exclusion criteria: allergy to investigational narcotic drugs; uncontrolled hypertension or hyperglycemia; liver and kidney dysfunction before surgery; severe bradycardia or atrioventricular block; thrombocytopenia or coagulopathy; mental disorders, Alzheimer's disease, or Parkinson's syndrome; substance abuse; and patients with skewed data results.

2.3. Anesthesia methods

Before stroke surgery, all patients underwent strict preoperative preparation to ensure smooth operation. One critical step was fasting, requiring patients to begin fasting on the morning of surgery for six to eight hours to avoid aspiration due to food or fluid reflux during the procedure, which could cause serious complications. Upon entering the operating room, medical staff used advanced equipment, such as the BeneView N15 monitor, to monitor vital signs including percutaneous oxygen saturation (SpO_2), heart rate (HR), mean arterial pressure (MAP), and respiratory rate (RR). These data allowed doctors to stay informed of the patient's status and make necessary adjustments. Oxygen was administered via a nasal cannula, typically at a flow rate of 2 L/min, to ensure adequate oxygenation.

In the study group, dezocine was administered 15 minutes before surgery as a powerful analgesic to relieve pain. Trained medical personnel administered the dosage based on the patient's specific condition. Propofol, a commonly used anesthetic, was used for anesthesia induction. The dose of propofol was adjusted based on the patient's weight and condition. Surgery commenced once the patient's eyelash reflex disappeared, indicating the onset of anesthesia. Throughout the procedure, vital signs were closely monitored, and if MAP dropped below 60 mmHg or HR fell below 50 beats per minute, appropriate measures and medications were administered. If the patient exhibited reactions such as body movement, frowning, or swallowing, the propofol infusion rate was adjusted to ensure the smooth progression of the surgery.

2.4. Observation indicators

In a controlled medical environment, multiple physiological parameters were measured during anesthesia, 1 hour after reperfusion, and 3 hours after reperfusion. To monitor changes in 5-hydroxytryptamine (5-HT) concentration, we used an advanced thiobarbituric acid method known for its specificity and sensitivity. Endothelin (ET) levels were measured using the radioimmunoassay (RIA) method, which allows for highly accurate identification of ET concentrations. Cerebral metabolic rate ($CMRO_2$), internal jugular venous oxygen content ($CjvO_2$), and the artery-internal jugular bulb oxygen difference ($Da\text{-}jvO_2$) were measured in real time using an ARM9 cerebral oximeter, providing valuable insights into brain ischemia-reperfusion injury and postoperative recovery.

Additionally, the occurrence of cerebral ischemia-reperfusion injury was carefully monitored to promptly detect and address any abnormalities. During the postoperative recovery phase, key recovery milestones, including eye-opening time, time from eye-opening to recovery of orientation, and time to extubation, were recorded. These data were crucial for assessing surgical outcomes and guiding future treatment and rehabilitation strategies. All procedures adhered to strict ethical standards to ensure patient safety and rights.

2.5. Statistical analysis

Data were entered and analyzed using SPSS 25.00 software. Two researchers independently collected, sorted, and double-checked the data before entry. The Kolmogorov-Smirnov test was used to assess the normal distribution of measurement data. Data following normal distribution were expressed as mean ± standard deviation (SD) and compared using repeated measures analysis of variance (spherical test corrected with the HF coefficient method) or independent sample t-tests. Count data were expressed as percentages (%) and compared using the χ^2 test. The significance level was set at $\alpha = 0.05$.

3. Results

3.1. Comparison of 5-HT and ET levels

There was no significant difference in the levels of 5-HT and ET between the two groups immediately after anesthesia and at 1 hour of reperfusion ($P > 0.05$). However, at 3 hours of reperfusion, the levels of 5-HT and ET in Group A were significantly lower than those in Group B ($P < 0.05$). Additionally, in Group A, the levels of 5-HT and ET at 3 hours of reperfusion were significantly lower than at 1 hour of reperfusion ($P < 0.05$). See **Table 1** for details.

Table 1. Comparison of 5-HT and ET levels between the two groups at different time periods (mean ± SD)

Groups	*n*	Metrics	Immediately after anesthesia	1 hour of reperfusion	3 hours of reperfusion
Group A	43	5-HT	3.87 ± 1.60	4.16 ± 1.12	3.37 ± 0.85*$^{\#}$
		ET	52.15 ± 12.37	54.96 ± 12.47	49.14 ± 10.45*$^{\#}$
Group B	43	5-HT	3.85 ± 1.62	4.29 ± 1.65	4.48 ± 1.73
		ET	51.73 ± 12.24	58.64 ± 16.38	66.31 ± 18.92

Compared with Group B,*$P < 0.05$; Compared with the same group at 1 h of reperfusion, $^{\#}P < 0.05$.

4. Discussion

This in-depth study revealed that in patients undergoing cerebral arterial thrombolysis for stroke, the use of propofol combined with an auxiliary anesthetic regimen can effectively enhance the anesthetic effect. This improvement is primarily due to propofol's minimal impact on hemodynamic indexes, as it quickly and smoothly produces sedative and hypnotic effects [6,7]. More importantly, when propofol is combined with a potent analgesic, a synergistic effect can occur, further enhancing its analgesic and sedative properties. This combined anesthesia approach not only shortens the time required to maintain anesthesia but also significantly improves the speed of anesthesia induction [8,9].

It is important to note that cerebral ischemia and hypoxia can lead to changes in 5-HT levels. After cerebral ischemia, 5-HT levels increase, especially when brain tissue experiences reperfusion injury, where its concentration rises significantly. This change reflects the state of lipid peroxidation. Additionally, when nerve cells experience hypoxia-ischemia, the secretion of ET increases abnormally [10-12]. In cases of brain tissue reperfusion injury, plasma ET levels rise further. The increase in ET concentration may lead to an elevated intracellular calcium ion (Ca^{2+}) concentration, which reduces cerebral blood flow and increases vascular resistance, thus exacerbating brain tissue injury. Excessive ET secretion can also enhance brain metabolism and trigger the release of excitatory amino acids, leading to further brain damage [13].

This study results show that the incidence of cerebral ischemia-reperfusion injury in Group A, where propofol was combined with an auxiliary anesthetic, was significantly lower than in Group B ($P < 0.05$). Additionally, at 3 hours post-reperfusion, the levels of 5-HT and ET in Group A were significantly lower than in Group B ($P < 0.05$). These findings indicate that propofol can reduce plasma concentrations of 5-HT and ET, thereby mitigating cerebral ischemia-reperfusion injury. The protective effect of propofol may be attributed, in part, to its ability to increase superoxide dismutase activity, which suppresses lipid peroxide production. The phenolic hydroxyl group in the molecular structure of propofol possesses strong antioxidant properties, competitively inhibiting lipid peroxidation and thus reducing 5-HT production. Moreover, propofol inhibits Ca^{2+} flow within vascular smooth muscle, counteracting ET-induced cerebrovascular contraction, which improves cerebral ischemia and hypoxia [14,15]. This not only reduces ET secretion but also provides a protective effect on cerebral blood vessels.

However, this study found that the two anesthetic methods did not significantly differ in their effects on brain metabolism indexes ($P > 0.05$), which contrasts with previous research findings. This discrepancy may be related to the smaller sample size in our study. Therefore, it is recommended to increase the sample size in future studies to further explore the combined effects of propofol and auxiliary anesthetics on brain metabolism.

In conclusion, during cerebral arterial thrombolysis for stroke patients, using an auxiliary anesthetic regimen combined with propofol not only significantly improves the anesthetic effect but also effectively reduces cerebral ischemia-reperfusion injury, offering considerable protection to the brain.

Disclosure statement

The authors declare no conflict of interest.

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