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# Effects of sevoflurane inhalation with different concentrations on the postoperative cognitive functions of elderly patients with diabetes.

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## Abstract

**Objective: To observe and analyse the effects of sevoflurane inhalation with different concentrations on the postoperative cognitive functions of elderly patients with diabetes.**
**Methods: Ninety cases of elderly diabetic patients undergoing laparoscopic gastrointestinal surgery were randomly selected in our hospital from January 2015 to September 2016. The patients were randomly divided into a low concentration group (n=45) and a high concentration group (n=45). Patients in the low concentration group inhaled 1.5% sevoflurane while those in the high concentration group inhaled 3% sevoflurane. The cognitive functions, blood glucose, and serum S100β protein levels of patients between the two groups were compared.**
**Results: Mini-Mental State Examination (MMSE) scores before anesthesia showed no significant difference between the two groups (P>0.05). However, the postoperative MMSE scores in the low concentration group in 6, 24, 48, and 72 h were significantly higher than those in the control group (P<0.05). The blood glucose levels showed no significant difference in the preoperative (1 h), intraoperative (1 h), postoperative (6, 24, 48, and 72 h) times between the two groups (P<0.05). The serum S100β protein levels of patients before anesthesia showed no significant difference between the two groups (P>0.05). The postoperative serum S100β protein levels of patients in the low concentration group in 6, 24, 48, and 72 h were significantly lower than those in the high concentration group (P<0.05).**
**Conclusion: A low concentration of sevoflurane anesthesia can alleviate the postoperative cognitive functions of elderly diabetic patients and inhibit the level of serum S100β protein. Therefore, the cognitive functions of the patients can rapidly recover.**

**Keywords:** Sevoflurane, Diabetes, Serum S100β protein, Cognitive functions.

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## Introduction

Elderly patients may experience alienation, impaired memory, personality change, and anxiety after large surgery. These phenomena are known as postoperative cognitive dysfunctions. The change of modern lifestyles is a contributing factor to the yearly increase of the incidence of diabetes, which seriously threatens human health. Diabetic patients have low tolerance to anesthesia. Moreover, the operation stimulation will lead to metabolic disorders and postoperative cognitive dysfunction in patients [1]. Therefore, the effects of sevoflurane inhalation with different concentrations on the postoperative cognitive function of elderly diabetic patients were observed and analysed in the current study to provide a reference for clinical treatment.

## General Data and Methods

### *General data*

Ninety cases of elderly diabetic patients undergoing laparoscopic gastrointestinal surgery were randomly selected in our hospital from January 2015 to September 2016. All the patients were diagnosed with type 2 diabetes with stable blood glucose levels. Cardiovascular diseases, liver and kidney dysfunctions, communication disorders, and mental diseases were excluded. This study was conducted with the consent of the medical ethics committee of our hospital and the patients, all of whom signed informed consent forms. The patients were divided into a low concentration group and a high concentration group through the random digital method: 24 male and 21 female cases aged 60-75 years (average age of 66.56 ± 3.35) were in the low concentration group, and 25 male and 20 female cases aged 61-74 years old (average age of 65.78 ± 3.27) were in the high concentration group. The sex, age, and other general data showed no significant difference between the two groups (P>0.05).

### Anesthesia methods

The blood pressure, heart rate, and ECG of patients were monitored. The patients underwent general anesthesia. They were intramuscularly injected with 0.5 mg atropine 30 min preoperatively. Then, 0.5 mg/kg midazolam, 4.0 μg/kg fentanyl, 0.9 mg/kg rocuronium, and 1.5 mg/kg propofol were used for anesthesia induction. The patients underwent tracheal intubation and mechanical ventilation. Propofol was used to maintain the anesthesia. Patients in the low concentration group inhaled 1.5% sevoflurane, while those in the high concentration group inhaled 3% sevoflurane. Micropump infusion of atracurium and remifentanil was used to maintain muscle relaxation and analgesia. The hemodynamics, blood pressure, and heart rate of patients were controlled during surgery [2].

### Observation index

The cognitive functions, blood glucose, and serum S100β protein levels of patients were observed and monitored before the anesthesia and at 6, 24, 48, and 72 h postoperatively. The cognitive functions of patients were assessed using the Mini-Mental State Examination (MMSE). Afterward, 4 ml fasting venous blood was collected, and the S100β protein level was monitored using the ELISA method [3].

### Statistical analysis

The data were processed using SPSS22.0 software. The measurement data were expressed as "$\bar{x}$ ± S" and compared using the t-test. The count data were expressed as "%" and compared using the $\chi^2$. P<0.05 indicated that the difference was significant [3].

## Results

### Comparison of the preoperative and postoperative cognitive functions between the two groups

The MMSE scores of patients between the two groups showed no significant difference before the anesthesia (P>0.05). The postoperative MMSE scores (6, 24, 48, and 72 h) in the low concentration group were significantly higher than those in the control group (P<0.05) (Table 1).

*Table 1. Comparison of the preoperative and postoperative cognitive functions between the two groups.*

| Groups | Before anesthesia | Postoperative 6 h | Postoperative 24 h | Postoperative 48 h | Postoperative 72 h |
|---|---|---|---|---|---|
| Observation group (45) | 29.59 ± 0.43 | 22.24 ± 0.32 | 25.78 ± 0.56 | 28.22 ± 0.21 | 29.29 ± 0.33 |
| Control group (45) | 29.65 ± 0.49 | 18.87 ± 0.43 | 21.66 ± 0.52 | 25.84 ± 0.43 | 27.66 ± 0.36 |
| t | 0.617 | 42.176 | 36.165 | 33.363 | 22.398 |
| p | 0.539 | 0 | 0 | 0 | 0 |

### Comparison of preoperative and postoperative blood glucose levels between the two groups

The blood glucose levels of the patients between the two groups showed no significant difference before anesthesia, intraoperatively (1 h), and postoperatively (6, 24, 48, and 72 h) (P<0.05) (Table 2).

*Table 2. Comparison of the preoperative and postoperative blood glucose levels between the two groups.*

| Groups | Before anesthesia | Intraoperative 1 h | Postoperative 6 h | Postoperative 24 h | Postoperative 48 h | Postoperative 72 h |
|---|---|---|---|---|---|---|
| Observation group (45) | 6.57 ± 2.15 | 7.64 ± 1.28 | 9.73 ± 1.14 | 8.67 ± 3.13 | 6.71 ± 2.38 | 6.19 ± 2.54 |
| Control group (45) | 6.83 ± 1.86 | 7.41 ± 1.33 | 9.46 ± 1.82 | 852 ± 3.59 | 6.43 ± 2.79 | 6.43 ± 2.97 |
| t | 0.613 | 0.836 | 0.843 | 0.211 | 0.512 | 0.414 |
| p | 0.541 | 0.406 | 0.401 | 0.833 | 0.609 | 0.680 |

### Comparison of the preoperative and postoperative S100β protein levels between the two groups

The serum S100β protein levels of patients showed no significant difference between the two groups (P>0.05). The protein levels of patients in the low concentration group 6, 24, 48, and 72 h postoperatively were significantly lower than those in the high concentration group (P<0.05), as shown in Table 3.

***Table 3.*** *Comparison of the preoperative and postoperative serum S100β levels between the two groups.*

| Groups | Before Anesthesia | Postoperative 6 h | Postoperative 24 h | Postoperative 48 h | Postoperative 72 h |
|---|---|---|---|---|---|
| Observation Group (45) | 0.11 ± 0.01 | 0.14 ± 0.02 | 0.15 ± 0.02 | 0.21 ± 0.04 | 0.13 ± 0.02 |
| Control Group (45) | 0.12 ± 0.04 | 0.17 ± 0.02 | 0.20 ± 0.03 | 0.39 ± 0.03 | 0.18 ± 0.03 |
| t | 1.626 | 7.115 | 9.302 | 24.149 | 9.302 |
| p | 0.107 | 0.000 | 0.000 | 0.000 | 0.000 |

## Discussion

The stress response of the central nervous system gradually decreases with increasing age, resulting in the constant reduction of cognitive ability under attack and pressure in elderly patients. Meanwhile, the stress response to general anesthesia and surgery in elderly patients is very strong, which leads to neurological damage and postoperative cognitive dysfunction [4]. Some scholars believe that anesthesia, hypoxia, and hypothermia can cease the activity of nerve cells. However, generally speaking, these conditions only affect short-term memory, not long-term memory [4]. Clinical research shows that surgery, anaesthetics, and intraoperative bleeding are related to postoperative cognitive dysfunction [5]. The cause of cognitive disorders in elderly diabetic patients might be diabetes combined with cerebrovascular diseases, metabolic disorders, and/or microvascular diseases. These disorders result in abnormal brain functions [6]. Serum S100β protein can be used to evaluate neurological function and cognitive impairment and is significant in evaluating prognosis. The benefits of sevoflurane use in anesthesia include rapid analgesic effect, good muscle relaxation effect, and rapid recovery time, among other advantages [7-9].

The effects of sevoflurane inhalation with different concentrations on the postoperative cognitive function of elderly diabetic patients were analysed in this study. The results showed that the MMSE score between the two groups before the anesthesia has no significant difference, but the postoperative MMSE scores of patients in the low concentration group (6, 24, 48, and 72 h) were significantly higher than those in the control group ($P<0.05$). The blood glucose levels showed no significant difference between the two groups preoperatively, 1 h intraoperatively, and 6, 24, 48, and 72 h postoperatively ($P<0.05$). The serum S100β protein levels of patients showed no significant difference preoperatively between the two groups ($P>0.05$). The postoperative serum S100β protein levels of patients in the low concentration group (6, 24, 48, and 72 h) were significantly lower than those of the high concentration group ($P<0.05$). The results showed that the higher the sevoflurane concentration, the higher the level of serum S100β protein, the lower the MMSE score, and the larger the probability of postoperative cognitive disorders, all of which are consistent with the findings of Liming et al. [10,11].

## Conclusion

To sum up, during sevoflurane inhalation anesthesia, a low concentration of sevoflurane can alleviate the effect of reduced postoperative cognitive functions in elderly diabetic patients and inhibit the increase of their serum S100β protein level. Therefore, the cognitive functions of the patients can rapidly recover.

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