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Review Article

Effects of different anesthesia methods on hemorheology and stress response in elderly patients undergoing endoscopic gastric cancer surgery

Cheng Wu[1], Neng Jiang[2], Jianlong Du[3], Zhipeng Zhu[1], Hongmei Zhou[1]

Departments of [1]Anesthesiology, [2]18 Ward, The Second Affiliated Hospital of Jiaxing University, Jiaxing 314000, Zhejiang, China; [3]Department of Anesthesiology, Tongxiang City First People's Hospital, Tongxiang 314500, China

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Abstract: Objective: To explore the effects of different anesthesia methods on hemorheology and stress response in elderly patients undergoing endoscopic gastric cancer surgery. Methods: 136 gastric cancer patients admitted to the oncology department of Second Affiliated Hospital of Jiaxing University were selected as research objects. 66 cases undergoing sevoflurane anesthesia were taken as sevoflurane group (SG). 70 cases undergoing propofol anesthesia were taken as propofol group (PG). General situation during operation and postoperative adverse reactions were recorded in both groups. Changes of hemodynamic indexes were observed before anesthesia (T0), after anesthesia induction for 3 min (T1), after establishment of pneumoperitoneum for 10 min (T2) and at the time of tube withdrawal (T3). Cognitive function was evaluated by mini-mental state examination (MMSE). Visual analogue scale (VAS) was used to evaluate pain and observe the stress indexes changes. Results: Tube withdrawal time, spontaneous respiration recovery time and awakening time in SG were significantly shorter than those of PG, but incidence of postoperative adverse reactions was higher than that of PG. There was no significant difference in hemodynamic indexes (SBP, DBP, HR) in both groups at T0. At T1-T3, SBP, DBP and HR in both groups were lower than those at T0, and SG was significantly lower than PG. MMSE score of PG was significantly higher than that of SG at 2 hours and 1 day after operation, while VAS score of SG after operation was significantly lower than that of PG. There was no significant difference in stress indexes ACTH, Cor and blood glucose levels in both groups before anesthesia. ACTH, Cor and blood glucose levels in SG were significantly higher than those in PG after tube withdrawal for 5 min. Conclusion: Sevoflurane was more conducive to maintaining hemodynamic stability during endoscopic surgery for elderly gastric cancer, but propofol could significantly reduce the stress response of elderly gastric cancer patients.

Keywords: Anesthesia, elderly, endoscopic, gastric cancer, hemorheology, stress

Introduction

Gastric cancer is a tumor formed in gastric wall tissue and it is the third leading cause of cancer death in the world [1]. Its incidence rate varies greatly in the world, with about 75% of cases occurring in developing countries [2]. As the disease is often diagnosed in the late stage, the prognosis of patients is poor, and the median overall survival time is less than 12 months [3]. At present, the clinical treatment of gastric cancer is mainly surgery, supplemented by chemotherapy and radiotherapy [4, 5]. Among them, Japan and other countries have taken laparoscopic surgery as one of the standard treatment methods for early gastric cancer. In recent years, with the development of medical instruments and surgical techniques, laparoscopic radical gastrectomy has certain therapeutic significance in the treatment of advanced gastric cancer patients [6]. However, when laparoscopic gastric cancer surgery is performed, the prognosis of patients is extremely affected due to poor anesthetic effect. Due to slow drug metabolism in the elderly, delayed recovery and emergency attack are often easily caused [7]. Therefore, anesthetic drugs for elderly patients undergoing laparoscopic gastric cancer surgery have become a major research focus. Sevoflurane, which is widely used in various diseases, is a new halogenated inhalation general anesthesia drug with the charac-

teristics of fast induction and high quality of postoperative recovery [8]. Propofol is a short-acting intravenous anesthetic commonly used in induction and maintenance of total anesthesia, with the advantages of rapid onset, stable induction and no excitement. It is also widely used in surgical operations [9]. Moreover, studies by Li et al. [10, 11] have shown that sevoflurane and propofol have good anesthetic effect in cardiac and colon cancer operations, but there are few reports on which of the two is more suitable for endoscopic surgery of gastric cancer in the elderly. At present, there are few studies at home and abroad to prove which of the two anesthesia methods is better. In this study, we evaluated the application of sevoflurane and propofol to elderly gastric cancer patients undergoing endoscopic surgery by comparing two different anesthesia methods and observing patients' hemorheology and stress response, so as to provide relevant reference basis for future clinical anesthesia treatment of elderly gastric cancer patients.

Materials and methods

Baseline data

From February 2017 to April 2019, 136 patients with gastric cancer admitted to the oncology department of the Second Affiliated Hospital of Jiaxing University were selected as research objects. 66 cases undergoing sevoflurane anesthesia were taken as SG. Another 70 cases undergoing propofol anesthesia were taken as PG. This study has been approved by the medical ethics committee of the Second Affiliated Hospital of Jiaxing University. Patients and their families have been informed in advance, and the informed consent has been signed.

Inclusion and exclusion criteria

All patients were diagnosed with gastric cancer by biopsy of the Second Affiliated Hospital of Jiaxing University's pathology department and they underwent endoscopic surgery in the Second Affiliated Hospital of Jiaxing University. Exclusion criteria were as follows: patients <60 years old; patients who cannot tolerate surgery; patients with narcotic allergy; patients with end-stage malignant diseases; patients who do not agree with the operation; patients with high risk of anesthesia; patients with coagulation disorders.

Methods

All patients underwent gastric cancer endoscopic surgery during the visit, which was completed by senior surgical clinicians in Second Affiliated Hospital of Jiaxing University. Routine intravenous channels were established to detect changes in patients' vital signs. Patients in both groups were induced with intravenous midazolam 0.04 mg/kg, sufentanil 0.4 μg/kg, propofol 2 mg/kg, cisbenzenesulfonate 0.2 mg/kg for anesthesia induction intubation, mechanical control ventilation after intubation. In the propofol group, TCI target controlled infusion was used to maintain anesthesia, and the target concentration of propofol plasma was set at 2-3 μg/ml; in the sevoflurane group, 2-3% sevoflurane was inhaled continuously to maintain anesthesia, with oxygen flow rate of 2 L/min and sevoflurane concentration ≥ 1.0 Mac. Patient controlled analgesia (PCA) was used for postoperative analgesia at a dose of sufentanil 1.0 μg/(kg•d) in both group for 72-120 h. PCA pump were diluted from 0.9% normal saline to 150 ml, the background dose was 2 ml/h, the single dose of PCA was 2 ml, the locking time was 10 min, and the maximum dose was 10 ml/h [12, 13].

Outcome measures

1. The time of tube withdrawal, spontaneous breathing recovery time and awakening time of patients were recorded in the two groups. 2. Adverse reactions were compared after operation. 3. The hemodynamic indexes (SBP, DBP, HR) were observed before anesthesia (T0), after anesthesia induction for 3 min (T1), after establishment of pneumoperitoneum for 10 min (T2), and at the time of tube withdrawal (T3). 4. Mini mental state examination (MMSE) was used to evaluate the cognitive function of patients in the two groups before anesthesia, after operation for 2 hours, after operation for 1 day and after operation for 7 days, with a full score of 30 points. The higher the score of the patients, the better the cognitive function. 5. Visual analogue scale (VAS) score was used to evaluate the postoperative pain of patients. The lower the score,

Table 1. Comparison of clinical data [n (%)]

	SG (n=66)	PG (n=70)	t or χ^2	P
Age	74.12±5.63	72.95±5.58	1.217	0.226
Gender			0.224	0.636
Male	36	41		
Female	30	29		
Weight	62.43±5.38	63.57±5.61	1.208	0.229
TNM stages			0.048	0.827
Stage I-II	28	31		
Stage III-IV	38	39		
Differentiation degree			0.000	0.984
Well differentiated	35	37		
Middle and poorly differentiated	31	33		
Smoking			0.230	0.631
Yes	21	25		
No	45	45		
Drinking			0.385	0.535
Yes	23	28		
No	43	42		

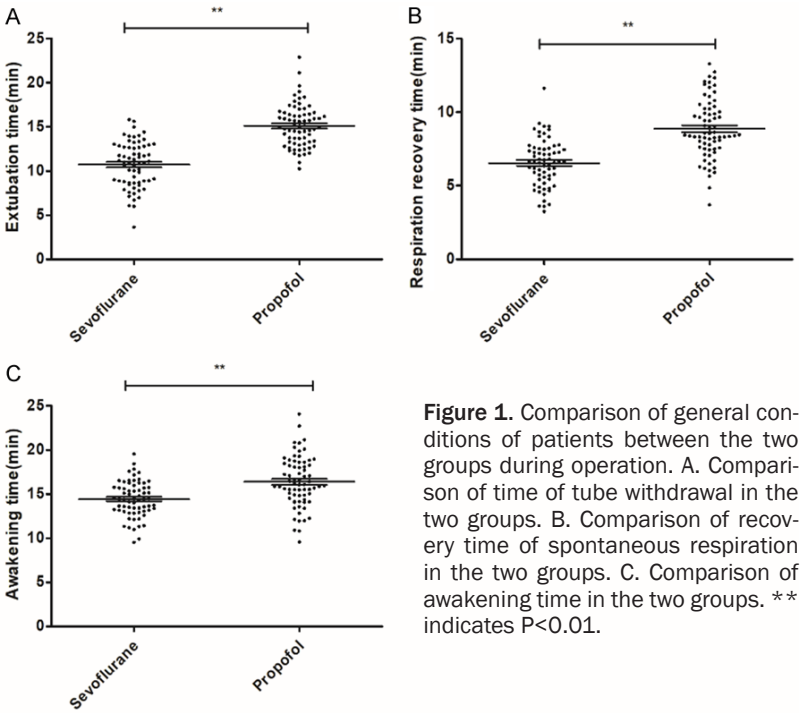

Figure 1. Comparison of general conditions of patients between the two groups during operation. A. Comparison of time of tube withdrawal in the two groups. B. Comparison of recovery time of spontaneous respiration in the two groups. C. Comparison of awakening time in the two groups. ** indicates P<0.01.

Statistical methods

In this experiment, SPSS-20.0 was used for statistical analysis of the collected data. GraphPad 5 was used to draw the required images. Counting data was expressed in the form of rate (%). Chi-square test was used for comparison between groups. The measurement data were expressed in the form of mean number ± standard deviation. T test was used for inter-group comparison. Multiple time points were compared by repetitive measurement and analysis of variance. LSD-t was used for back-test. The difference was statistically significant with P< 0.05.

Results

Comparison of the baseline data

In order to make the experimental results accurate, there was no significant difference in clinical data of age, gender, body weight, TNM stage, differentiation degree, smoking and drinking between the two groups (P>0.05), proving the comparability. More details are shown in **Table 1**.

Comparison of general conditions between the two groups during operation

the better the pain. 6. Stress reaction: Peripheral venous blood was taken at two time points before anesthesia and after tube withdrawal for 5 min. ACTH and Cor levels were detected by electrochemical method. Blood glucose levels were measured by blood glucose meter.

Compared with patients in the two groups, the respiratory frequency during spontaneous breathing was up to 14~20 times/min, and SpO2 was more than 95% when they inhaled. The recovery of respiratory reflex and basic consciousness were the recovery time of spontaneous respiration, tube withdrawal time and

Table 2. Comparison of postoperative adverse reactions

Grouping	Nausea and vomiting	Vertigo	Headache	Cough	Incidence of adverse reactions
SG (n=66)	3 (4.55)	4 (6.06)	3 (4.55)	4 (6.06)	14 (21.21)
PG (n=70)	2 (2.86)	2 (2.86)	1 (1.43)	1 (1.43)	6 (8.57)
χ^2					4.327
P					0.038

Table 3. Comparison of SBP levels (mm/Hg) in the two groups during anesthesia

Grouping	T0	T1	T2	T3
SG (n=66)	124.68±4.15	108.97±3.17[a]	114.78±3.55[a]	120.64±3.74[a]
PG (n=70)	123.93±4.03	110.29±3.26[a]	116.35±3.72[a]	122.35±3.98[a]
t	1.069	2.392	2.515	2.578
P	0.287	0.018	0.013	0.011

a: compared with T0, P<0.05.

Table 4. Comparison of DBP levels (mm/Hg) in the two groups during anesthesia

Grouping	T0	T1	T2	T3
SG (n=66)	80.63±3.21	72.59±2.47[a]	75.25±2.71[a]	78.21±2.94[a]
PG (n=70)	81.44±3.35	73.66±2.58[a]	76.34±2.84[a]	79.38±3.16[a]
t	1.438	2.468	2.287	2.232
P	0.153	0.015	0.024	0.027

a: compared with T0, P<0.05.

Table 5. Comparison of HR levels (times/minute) in the two groups during anesthesia

Grouping	T0	T1	T2	T3
SG (n=66)	84.75±5.39	65.71±4.26[a]	68.49±4.62[a]	76.16±4.88[a]
PG (n=70)	85.32±5.57	67.45±4.51[a]	70.19±4.78[a]	78.12±5.03[a]
t	0.606	2.310	2.107	2.304
P	0.546	0.022	0.037	0.023

a: compared with T0, P<0.05.

awakening time. The time of tube withdrawal in SG was 10.78±2.16 min, which was significantly shorter than that of PG (15.12±2.49 min), P<0.01. The recovery time of spontaneous respiration in SG (6.51±1.74 min) was significantly shorter than that in PG (8.43±1.97 min), P<0.01. The awakening time of SG (14.13±2.36 min) was significantly shorter than that of PG (16.35±2.54 min), P<0.01. More details are shown in **Figure 1**.

Comparison of postoperative adverse reactions between the two groups

The adverse reactions after operation were compared between the two groups. Analysis indicated that the incidence of adverse reactions in SG (21.21) was significantly higher than that in PG (8.57), P<0.05. More details are shown in **Table 2**.

Comparison of hemorheology of patients in the two groups at different time points

At T0, there was no significant difference in SBP, DBP and HR of patients between the two groups (P>0.05). At T1-T3, SBP, DBP and HR of patients in the two groups were significantly lower than those at T0 (P<0.05), while SBP, DBP and HR levels in PG were significantly higher than those in SG (P< 0.05) at T1-T3. More details are shown in **Tables 3**-**5**.

Comparison of MMSE scores of patients in the two groups at different time points

There was no significant difference in MMSE scores between the two groups before anesthesia and after operation for 7 days (P> 0.05). MMSE scores in PG were significantly higher than those in SG after operation for 2 hours and 1 day (P<0.01). More details are shown in **Table 6**.

Visual analogue scale (VAS) was used to evaluate the postoperative pain of patients

The VAS score was 2.68±0.36 in SG and 3.15±0.39 in PG. The VAS scores of SG was significantly lower than that of PG, P<0.01. More details are shown in **Figure 2**.

Comparison of stress response related indicators at different time points

There was no significant difference in ACTH, Cor and blood glucose levels in the two groups before anesthesia (P>0.05). ACTH, Cor and blood glucose levels in SG were significantly higher than those in PG after tube withdrawal

Table 6. Comparison of MMSE scores

Grouping	Before anesthesia	After operation for 2 h	After operation for 1 day	After operation for 7 day
SG (n=66)	28.68±0.63	21.64±0.47	24.96±0.53	28.45±0.62
PG (n=70)	28.49±0.61	22.46±0.51	25.41±0.57	28.39±0.59
t	1.787	9.659	4.771	0.578
P	0.076	0.000	0.000	0.564

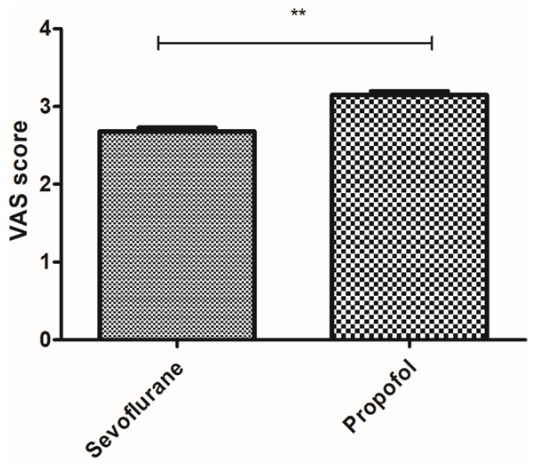

Figure 2. Comparison of VAS scores of patients in the two groups. ** indicates P<0.01.

for 5 min (P<0.01). More details are shown in **Table 7**.

Discussion

The elderly have poor physical function and many of them suffer from a variety of basic diseases. Under the background of the global aging, it has caused some obstacles to the social progress. At the same time, it has increased the medical burden to a certain extent. As the aging population increases, the proportion of gastric cancer in elderly patients will continue to increase [14]. Gastric cancer is also one of the major causes of cancer-related deaths in less-developed countries [15]. Traditional laparotomy radical operation for gastric cancer is the main treatment method for gastric cancer clinically. However, due to the decreased physical functions of the elderly and the large surgical trauma, the prognosis of the patients is poor [16]. With the development of laparoscopic instruments and the accumulation of operation experience, laparoscopic gastrectomy has gradually developed into a new treatment method for gastric cancer in the elderly [17] due to the small trauma and less postoperative complications. However, due to the need for anesthesia in the operation, elderly patients are often prone to adverse reactions related to anesthesia stress. Due to the large changes in intraoperative hemodynamics and the decline in immune function, improving the anesthetic quality of laparoscopic gastric cancer surgery has become a research hotspot and challenge for domestic and foreign scholars [18]. In recent years, the main anesthetic drugs include sevoflurane and propofol. A study by Potočnik et al. [19] indicated that volatile anesthetic sevoflurane has systemic anti-inflammatory effect and it has fewer major postoperative complications. However, studies by Folino et al. [20] indicated that propofol has a protective effect on the brain and can reduce oxidative damage and apoptosis of brain cells in rat models. At present, there are few articles about comparing the application value of the two drugs at home and abroad. Therefore, this article aimed to verify which drug was more suitable for clinical use by comparing the effects of sevoflurane and propofol on hemorheology and stress response in elderly gastric cancer patients undergoing endoscopic surgery, and to provide relevant reference and selection basis for future treatment of such diseases.

In the results of this study, the time of tube withdrawal, spontaneous breathing recovery time and awakening time of patients in SG were significantly shorter than those in PG, and the postoperative VAS score of patients in SG was lower, indicating that the analgesic effect of sevoflurane anesthesia was more obvious than that of propofol. This is consistent with the research results of Ortiz et al. [21], and it can be used to support our experimental results. However, the incidence of postoperative adverse reactions was higher in SG. It was speculated that it was related to anesthesia methods. This may cause postoperative cough and other adverse reactions in patients with sevoflurane inhalation anesthesia to stimulate the respiratory tract. In the following research, we concluded that the SBP, DBP and HR levels of the two groups were not significantly different at T0. At T1-T3, they were significantly lower than that at T0. The SBP, DBP and HR levels of

Table 7. Comparison of stress response related indicators in the two groups

Indexs	Grouping	Before anesthesia	After tube withdrawal for 5 min
ACTH (pg/mL)	SG (n=66)	63.82±7.26	71.45±7.60[#]
	PG (n=70)	63.19±7.22	66.82±7.51[#,b]
Cor (nmol/L)	SG (n=66)	552.48±39.21	654.18±43.29[#]
	PG (n=70)	551.69±38.85	621.32±41.65[#,b]
Blood glucose (mmol/L)	SG (n=66)	4.75±0.67	6.43±0.85[#]
	PG (n=70)	4.59±0.59	5.86±0.78[#,b]

[#]indicates: compared with before anesthesia, P<0.01; b: compared with SG, P<0.01.

SG were significantly lower than those of PG at T1-T3, which indicated that sevoflurane could better maintain the stability of hemodynamics and protect the heart during surgery. Combined with the research of Brioni et al. [22], it was found that volatile anesthetic can affect cardiovascular system by itself or by reducing systemic vascular resistance. However, the MMSE scores of patients in PG were significantly higher than those in SG at 2 h and 1 d after operation. There was no significant difference between PG and SG before anesthesia and 7 d after operation, which indicated that propofol had less influence on postoperative cognitive function of elderly gastric cancer patients undergoing endoscopic surgery. Research of Xiong et al. [23] proved that sevoflurane could cause a large loss of cholinergic neurons in basal forebrain, leading to impairment of spatial memory and fear memory, and subsequent cognitive deficits by significantly reducing the level of nerve factors. Research of Liu et al. [24] also believed that sevoflurane was involved in the development of mild cognitive impairment. Finally, we found that there was no significant difference in ACTH, Cor and blood glucose levels between the two groups before anesthesia. However, after tube withdrawal for 5 min, ACTH, Cor and blood glucose levels in the two groups were significantly higher than those before anesthesia. The increase in SG was more significant than that in PG, indicating that sevoflurane and propofol can both have different degrees of stress reactions. However, propofol could better inhibit stress reactions compared with sevoflurane. Research of Jung et al. [25] believed that propofol could reduce perioperative norepinephrine and glucose reactions, thus alleviating stress reactions of patients. It can support our results.

This experiment was designed to discuss which anesthesia method was more suitable for elderly gastric cancer patients undergoing endoscopic surgery by observing the intraoperative general situation, postoperative adverse reactions, hemodynamic indexes at different time points, cognitive function, pain situation and stress reaction of patients in the two groups. However, the specific mechanism of action with sevoflurane and propofol still needs to be further explored. Due to the limited experimental conditions, we cannot know whether the experimental results are suitable for other disease surgery. Therefore, we will continuously improve the experimental design in future research to obtain the best experimental results.

To sum up, in elderly gastric cancer endoscopic surgery, PG patients' time of tube withdrawal, spontaneous breathing recovery time and awakening time were longer than those in SG, and SG had less postoperative pain, which was more conducive to maintaining hemodynamic stability. Patients in PG had fewer postoperative adverse reactions. It could effectively shorten the time of postoperative cognitive dysfunction, and it could significantly reduce the stress response of elderly gastric cancer patients.

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Disclosure of conflict of interest

None.

Address correspondence to: Hongmei Zhou, Department of Anesthesiology, The Second Affiliated Hospital of Jiaxing University, 1518 North Huancheng Road, Jiaxing 314000, Zhejiang, China. E-mail: zjjxmzwucheng@163.com

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