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Review Article

Effect of epidural block anesthesia combined with general anesthesia on postoperative cognitive ability of elderly patients undergoing thoracoscopic surgery

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Abstract: This study was designed to explore the effect of epidural block anesthesia combined with general anesthesia on postoperative cognitive ability of elderly patients undergoing thoracoscopic surgery. A total of 115 elderly patients undergoing thoracoscopic surgery in our hospital were collected as study subjects. Among them, 65 patients treated by epidural block anesthesia combined with general anesthesia were designated group A and 50 cases with general anesthesia were designated group B. The mini-mental state examination (MMSE) score, Montreal cognitive assessment scale (MoCA), adrenaline, cortisol, visual analogue scale (VAS) and incidence of adverse reactions between the two groups were compared, and the risk factors affecting postoperative cognitive ability of elderly patients undergoing thoracoscopic surgery were analyzed. The preoperative MMSE score, MoCA score, adrenaline, and cortisol levels were not significantly different between both groups. The postoperative MMSE score and MoCA score in group A were significantly higher than those of group B, while adrenaline and cortisol were significantly lower than those of group B. The postoperative VAS score was significantly lower than that of group B. There was no remarkable difference in the incidence of postoperative adverse reactions between the two groups. Age, hypertensive history, operation time, years of education, and anesthesia methods are risk factors that affect the postoperative cognitive ability of elderly patients undergoing thoracoscopic surgery. Epidural block anesthesia combined with general anesthesia can improve their postoperative cognitive ability and dramatically reduce stress response and pain during surgery.

Keywords: Epidural block anesthesia, general anesthesia, thoracoscope, cognitive ability, stress response

Introduction

Thoracoscopic surgery is a visual minimally invasive thoracic surgery requiring anesthesia forerunner [1]. It can be widely used in settings such as lobectomy, diagnosis of hydrothorax, and treatment of pleural diseases [2-4]. Compared with open surgery, it has less pain, shorter hospital stay, and a lower incidence of complications and discharge mortality [5, 6]. With the advancement of medical technology, the continuous optimization of thoracoscopic surgery has also promoted progress in anesthesia management. Rapid and complete rehabilitation, appropriate postoperative analgesia, and optimal medical cost have become demands of accurate anesthesia [7, 8]. Therefore, a study of the anesthesia strategy of thoracoscopic surgery might improve patients' satisfaction and postoperative recovery.

General anesthesia is associated with adverse prognosis such as postoperative cognitive dysfunction due to its harmful systemic side effects [9]. Postoperative cognitive dysfunction is a common complication in the elderly and it has a great negative impact on the quality of life and economic burden [10]. Therefore, in order to reduce the side effects such as cognitive dysfunction, we planned to adopt the strategy of general anesthesia combined with epidural block anesthesia to verify whether it could reduce side effects such as cognitive dysfunction of elderly patients compared with general anesthesia alone. Epidural block anesthesia is a local anesthesia that it is widely used in tho-

racic surgery due to its analgesic effect covering the chest wall and pleural cavity and cough reflex without operation [11]. In addition, it can also reduce immunosuppression and neuroendocrine stress, and it is instrumental in improving the survival rate of patients and tumor recurrence [12]. However, it also has inevitable and unnecessary bilateral block and complications [13]. Previous studies have reported that epidural block anesthesia combined with general anesthesia will not affect hypoxic pulmonary vasoconstriction and has little effect on pulmonary and systemic hemodynamics. However, there is controversy over the risk of postoperative cognitive dysfunction between the two. It is still unclear whether general anesthesia or local anesthesia is beneficial to the reduction of postoperative cognitive dysfunction [14, 15].

At present, there are few related studies on the effect of epidural block anesthesia combined with general anesthesia on postoperative cognitive ability of elderly patients undergoing thoracoscopic surgery. This study will analyze the cognitive function scores of elderly patients after thoracoscopic surgery using this anesthesia technology, hoping to provide a clinical reference for anesthesia selection of the elderly.

Materials and methods

General information

A total of 115 elderly patients who underwent thoracoscopic surgery in Shanxi Medical University from February 2016 to June 2018 were collected as the research subjects. Among them, 65 patients underwent epidural block anesthesia combined with general anesthesia were considered as group A, 38 males and 27 females, aged 60-79 years, with an average age of 70.69±8.33 years, while 50 who underwent general anesthesia were deemed group B, 30 males and 20 females, with an average age of 69.98±8.20 years. Inclusion criteria: those met grade I-II based on the American Society of Anesthesiologists (ASA) [16]; those whowere suitable for thoracoscopic surgery; normal heart, lung, liver and kidney function. There was no surgical history within six months. Exclusion criteria: those who had drugs orally within six months that might affect the results of this study; those had mental abnormality or those who could not communicate normally; those who had abnormal thoracic vertebrae. The study was approved by the ethics committee of Shanxi Medical University. The subjects and their guardians were informed and they signed a fully informed consent form.

Anesthesia methods

In group A, epidural block anesthesia combined with general anesthesia was applied: Epidural puncture was performed in the space between the 6th and 7th thoracic vertebrae, and epidural catheter was placed upwards; 5.0 mL 1.5% lidocaine was injected (Shanghai Hengfei Biotechnology Co., Ltd., China, SL8860), the block plane was controlled after the 3rd to 11th thoracic vertebrae, 10.0 mL 1.5% lidocaine was continuously injected, and 1.0 mg/kg propofol (Shanghai Yuanye Biotechnology Co., Ltd., China, B33792-100 mg), 4.0 μg/kg fentanyl (China Jiangsu Nhwa Pharmaceutical Co., Ltd., H20143315), 0.1 mg/kg midazolam (China Shanghai Zzstandard Biotechnology Co., Ltd., ZWK-135-13791), and 0.1 mg/kg vecuronium (China Zhejiang Xianju Pharmaceutical Co., Ltd., H19991172) were injected intravenously and inserted into a double-lumen endobronchial tube; 1.0% sevoflurane (China Shanghai Xiyuan Biotechnology Co., Ltd., XY-EP-Y0001046) was used to maintain anesthesia.

Group B received general anesthesia: 2.0 μg/kg fentanyl, 0.2 mg/kg midazolam (China Jiangsu Nhwa Pharmaceutical Co., Ltd., H10-980025), and 1.0 mg/kg Vecuronium Bromide (Shanghai Yuanye Biotechnology Co., Ltd., China, S65949) were used for intravenous injection, tracheal intubation and ventilator-assisted ventilation, and 4.0 mg/kg propofol (Shanghai Xiyuan Biotechnology Co., Ltd., China, XY-EP-Y0000016) or fentanyl was used to maintain anesthesia.

Cognitive function and pain assessment

The cognitive function of the two groups before and after treatment was evaluated by mini-mental state examination (MMSE) [17] and Montreal cognitive assessment scale (MoCA) [18]. MMSE scoring criteria: According to the educational level of patients, ≥ 27 was normal, and illiterate patients ≤ 17, primary schools ≤ 20, secondary schools ≤ 22, and universities ≤ 23 were classified as cognitive impairment. The MoCA score scale has a total score of 30 points,

Table 1. Baseline data of patients in the two groups [n (%), mean ± SD

Factor	n	Group A (n = 65)	Group B (n = 50)	χ^2/t	P
Gender				0.028	0.868
Male	68	38 (58.46)	30 (60.00)		
Female	47	27 (41.54)	20 (40.00)		
Age (years)				0.996	0.318
< 70	56	29 (44.62)	27 (54.00)		
≥ 70	59	36 (55.38)	23 (46.00)		
Average age (years)	115	70.69±8.33	69.98±8.20	0.456	0.649
History of hypertension				1.762	0.184
No	54	27 (41.54)	27 (54.00)		
Yes	61	38 (58.46)	23 (46.00)		
History of diabetes				0.147	0.701
No	46	25 (38.46)	21 (42.00)		
Yes	69	40 (61.54)	29 (58.00)		
Drinking history				0.257	0.612
No	56	33 (50.77)	23 (46.00)		
Yes	59	32 (49.23)	27 (54.00)		
Smoking history				0.168	0.682
No	55	30 (46.15)	25 (50.00)		
Yes	60	35 (53.85)	25 (50.00)		
Diet				0.104	0.747
Light	81	45 (69.23)	36 (72.00)		
Spicy	34	20 (30.77)	14 (28.00)		
Place of residence				0.953	0.329
Countryside	33	21 (32.31)	12 (24.00)		
Cities and towns	82	44 (67.69)	38 (76.00)		
Operation time (min)				0.246	0.620
< 180	49	29 (44.62)	20 (40.00)		
≥ 180	66	36 (55.38)	30 (60.00)		
Education (years)	115	4.98±2.10	5.32±2.46	0.799	0.426

Table 2. Incidence of adverse reactions in the two groups [n (%)]

Group	n	Nausea and vomiting	Dizziness and lethargy	Dysphoria
Group A	65	1 (1.54)	3 (4.62)	4 (6.15)
Group B	50	2 (4.00)	1 (2.00)	2 (4.00)
χ^2 value	-	0.674	0.576	0.265
P value	-	0.412	0.448	0.607

and < 26 indicates a decline in cognitive function, with a normal score of 26 points. If the cultural background and years of education are less than 12 years, the score will be increased by 1 point.

The degree of postoperative pain in the two groups was evaluated by visual analogue scale (VAS) [19]. We quantified the pain degree of patients with a score of 0-10. A higher score indicates a greater degree of pain.

Detection indicators

The MMSE score, MoCA score, adrenaline, and cortisol levels before and after operation were compared between the two groups. Adrenaline was detected by High Performance Liquid Chromatography (Shenzhen Yixin Instrument and Equipment Co., Ltd., GI-3000-12). Serum cortisol was detected by chemiluminescence apparatus (Beijing North Institute of Biotechnology Co., Ltd., AUTO-AE2100, China). VAS scores and incidence of adverse reactions were compared between the two groups.

Statistical analysis

SPSS22.0 (Beijing Bioeasy Technology Co., Ltd., China) was used for statistical analysis. The counting data were expressed by the number of cases/percentage [n (%)], and their comparison between groups was conducted by Chi-square test. When the theoretical frequency in Chi-square test was less than 5, we adopted the continuity correction Chi-square test. The measurement data were expressed by mean ± SD, and their comparison between groups was conducted by independent-samples T test. Paired T test was applied before and after treatment in the group. The risk factors affecting the postoperative cognitive ability of elderly patients undergoing thoracoscopic surgery were assessed through logistic regression analysis. A *p* value lower than 0.05 was considered significant.

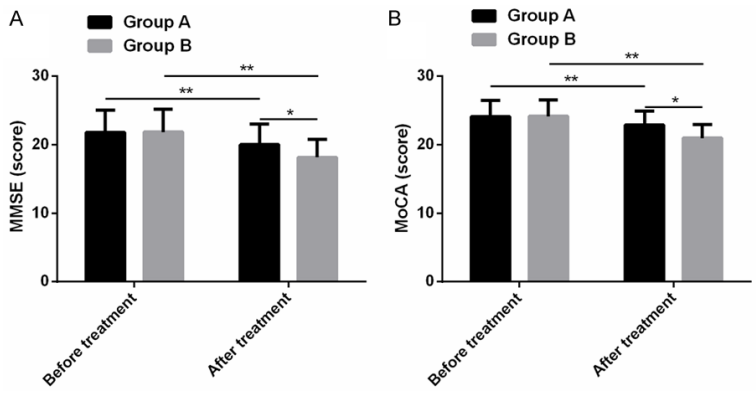

Figure 1. Postoperative cognition of elderly patients undergoing thoracoscopic surgery. A. MMSE score in group A was significantly decreased after operation, but still higher than that in group B. B. MoCA score in group A was significantly decreased after operation, but still higher than that in group B. Note: *P<0.05, **P<0.01.

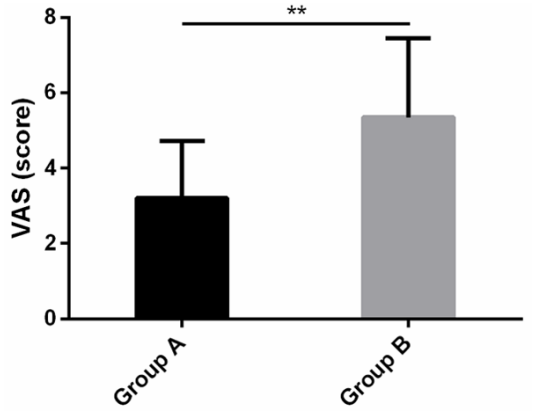

Figure 2. VAS scores in group A were significantly lower than those in group B. Note: **P<0.01.

Results

Baseline data

There were no obvious differences in gender, age, average age, hypertension history, history of diabetes, drinking, or smoking, diet, place of residence, operation time, and years of education between the two groups (P<0.05). More details are shown in **Table 1**.

Occurrence of adverse reactions in the two groups

After treatment, there was no remarkable difference in the incidence of nausea, vomiting, dizziness, lethargy, dysphoria, and other adverse reactions between the two groups (P> 0.05). More details are shown in **Table 2**.

Results of MMSE score and MoCA score before and after treatment in elderly patients undergoing thoracoscopic surgery

There was no marked difference in MMSE score and MoCA score between the two groups before treatment (P>0.05). The two scores in the two groups after treatment were dramatically higher than those before treatment (P<0.05), and those in group A were dramatically higher than those in group B after treatment (P<0.05). Details are shown in **Figure 1**.

VAS scores of elderly patients undergoing thoracoscopic surgery

There was no marked difference in preoperative VAS scores between the two groups (P>0.05), and those in group A were dramatically lower than those in group B (P<0.05). Details are shown in **Figure 2**.

Levels of adrenaline and cortisol in elderly patients undergoing thoracoscopic surgery

There was no obvious difference in adrenaline and cortisol between the two groups before operation (P>0.05), but their levels after operation increased markedly (P<0.05), and their levels in group A were dramatically lower than those in group B (P<0.05). Details are shown in **Figure 3**.

Multivariate Logistic regression analysis on postoperative cognitive ability of elderly patients undergoing thoracoscopic surgery

There were 18 patients with cognitive dysfunction. The differences of clinical measures and related indexes between patients with cognitive impairment (group C) and those without cognitive impairment (group D) were compared. There were no marked differences in gender, average age, history of diabetes, drinking, or smoking, diet, place of residence and operation history between the two groups (P>0.05), while there were statistical differences in age, hypertension history, operation time, years of education and anesthesia methods (P<0.05).

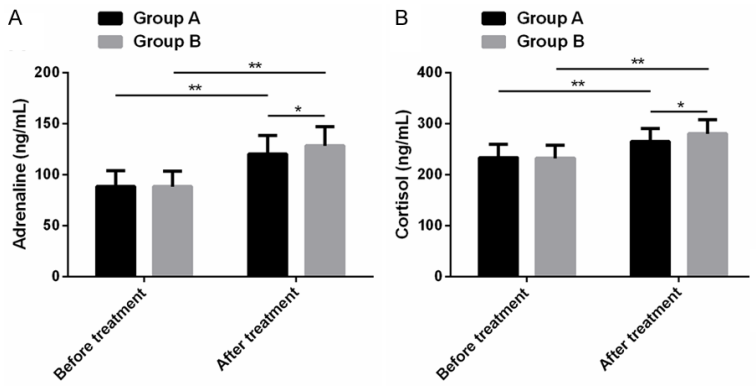

Figure 3. Adrenalin and cortisol levels in elderly patients undergoing thoracoscopic surgery. A. The level of adrenaline in group A increased significantly after operation, but it was still significantly lower than that of group B. B. The level of cortisol in group A increased significantly after operation, but was still significantly lower than that of group B. Note: *P<0.05, **P<0.01.

Multivariate Logistic regression analysis was conducted on the different factors. The results showed that age (P = 0.040), hypertension history (P = 0.003), operation time (P = 0.001), years of education (P = 0.004), and anesthesia method (P = 0.002) were independent risk factors affecting postoperative cognitive ability of elderly thoracoscopic surgery patients. The risk of postoperative cognitive dysfunction increases for elderly patients undergoing thoracoscopic surgery with advanced age, hypertension history, long operation time, low years of education, and simple general anesthesia. Details are shown in **Tables 3**-**5**.

Discussion

Postoperative cognitive dysfunction is characterized by slight impairment of memory, attention and information processing rate, which is a common complication of elderly patients. Inducing factors may involve imbalance of inflammatory factors and anesthesia type [20, 21]. According to a study, about 25.8% of the elderly patients suffered from cognitive dysfunction one week after surgery, and about 9.9% of those suffered from cognitive dysfunction three months after surgery [22]. Therefore, the study of anesthesia strategy is of great value to reduce the risk of postoperative cognitive dysfunction in elderly patients.

Studies have been done on the relationship between anesthesia and postoperative cognitive function. For example, in elderly patients, Tzimas and others [23] found that general anesthesia might lead to their long-term cognitive dysfunction, and frequent general anesthesia had great harm to cognitive function. According to animal experiments, general anesthesia had neurotoxic side effects, which might be a cause of cognitive impairment in elderly patients [24]. However, Bryson and others [25] reported that there was no remarkable difference between the effects of local anesthesia and general anesthesia on cognitive dysfunction. This study compared epidural block anesthesia combined with general anesthesia versus general anesthesia alone to verify whether combined anesthesia is beneficial to reduce postoperative cognitive dysfunction in elderly patients. MMSE and MoCA are the cognitive assessment tools we used. Both of them are scoring systems for the diagnosis of cognitive dysfunction. MMSE has higher clinical diagnostic specificity, while MoCA has higher sensitivity and accuracy [26]. Therefore, we chose two screening tools to ensure the accuracy of the research results. Our research results signify that MMSE and MoCA scores in group A are significantly higher than those in group B, suggesting that epidural block anesthesia combined with general anesthesia has less influence on postoperative cognitive ability of elderly patients and is more conducive to reducing their postoperative cognitive dysfunction. With regard to the basis of self-controlled epidural anesthesia, Wang and others [27] verified that epidural block anesthesia combined with general anesthesia allowed a lower incidence of cognitive dysfunction from the first day to the sixth day after surgery compared with general anesthesia, suggesting that general combined local anesthesia was better for the recovery of cognitive function of elderly patients, similar to this study. This study also showed that postoperative VAS score in group A was markedly lower than that in group B, and with the passage of postoperative time, adrenaline and cortisol in group A both were at lower levels, which meant that combined anesthesia caused lower pain and stress response. Other studies have shown that epidural block anesthesia combined with general anesthesia has a lower inci-

Table 3. Relationship between clinical measures and various indicators in elderly patients undergoing thoracoscopic surgery and cognitive dysfunction [n (%)]

Category	n	Group C (n = 18)	Group D (n = 97)	χ^2	P
Gender				0.502	0.479
Male	68	12 (66.67)	56 (57.73)		
Female	47	6 (33.33)	41 (42.27)		
Age (years)				5.987	0.014
< 70	56	4 (22.22)	52 (53.61)		
≥ 70	59	14 (77.78)	45 (46.39)		
Average age (years)	115	71.25±6.94	69.51±7.28	0.938	0.350
History of hypertension				7.861	0.005
No	54	3 (16.67)	51 (52.58)		
Yes	61	15 (83.33)	46 (47.42)		
History of diabetes				2.810	0.094
No	46	4 (22.22)	42 (43.30)		
Yes	69	14 (77.78)	55 (56.70)		
Drinking history				0.015	0.904
No	56	9 (50.00)	47 (48.45)		
Yes	59	9 (50.00)	50 (51.55)		
Smoking history				0.683	0.409
No	55	7 (38.89)	48 (49.48)		
Yes	60	11 (61.11)	49 (50.52)		
Diet				2.269	0.132
Light	81	10 (55.56)	71 (73.20)		
Spicy	34	8 (44.44)	26 (26.80)		
Place of residence				0.437	0.509
Countryside	33	4 (22.22)	29(29.90)		
Cities and towns	82	14 (77.78)	68 (70.10)		
Operation time (min)				5.873	0.015
< 180	49	5 (27.78)	44 (45.36)		
≥ 180	66	13 (72.22)	53 (54.64)		
Education (years)	115	4.40±2.03	5.79±2.79	2.014	0.046
Anesthesia method				4.669	0.031
Combination	65	6 (33.33)	59 (60.82)		
General anesthesia alone	50	12 (66.67)	38 (39.18)		

dence of complications compared with general anesthesia [28]. At the end of this study, the risk factors affecting the postoperative cognitive ability of elderly patients undergoing thoracoscopic surgery were also discussed. The results pointed out that the risk of postoperative cognitive dysfunction of elderly patients undergoing thoracoscopic surgery with advanced age, hypertension history, long operation time, low years of education and general anesthesia alone increased. Kok and others [29] confirmed that high education level was more conducive to the recovery of cognitive ability of patients, similar to the results of this study. Recently, there have also been studies on the effects of anesthesia on children's cognitive function. Whether it is dental surgery, selective hernia surgery, or general anesthesia, short-term visual memory impairment appears after children's surgery [30, 31]. This may be related to neurodevelopmental deficits in children caused by early anesthesia [32].

To summarize, epidural block anesthesia combined with general anesthesia is more conducive to the recovery of postoperative cognitive ability, stress response, and pain relief of elderly patients undergoing thoracoscopic surgery. Moreover, advanced age, hypertension history, long operation time, low years of education and general anesthesia alone are not conducive to the recovery of postoperative cognitive function of elderly patients undergoing thoracoscopic surgery. However, there is still room for improvement. In the first place, we can study the specific mechanisms of cognitive function regulation of the two anesthesia types for elderly patients undergoing thoracoscopic surgery, and explore potential prevention or treatment targets. In the second place, it is also possible to expand the sample range, explore the relevant effects of two kinds of combined anesthesia on other populations, and verify whether the results are universal for all populations.

Disclosure of conflict of interest

None.

Table 4. Logistic multivariate regression analysis assignment

Factor	Variable	Assignment
Age (years)	X1	<70 = 0, ≥70 = 1
History of hypertension	X2	No = 0, yes = 1
Operation time (min)	X3	<180 = 0, ≥180 = 1
Education (years)	X4	The data belong to continuous variables and are analyzed with original data.
Anesthesia methods	X5	Combination = 0, simple general anesthesia = 1

Table 5. Multivariate Logistic regression analysis of cognitive function in elderly patients undergoing thoracoscopic surgery

Variable	B	S.E	Wals	P	OR	95% CI
Age (years)	1.048	0.529	5.383	0.040	2.441	1.206-6.562
History of hypertension	0.329	0.013	9.036	0.003	1.315	1.139-1.827
Operation time (min)	0.122	0.036	13.037	0.001	1.118	1.057-1.161
Education (years)	1.353	0.470	8.583	0.004	4.007	1.613-10.363
Anesthesia methods	1.901	0.082	9.881	0.002	6.579	2.265-13.564

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