ORIGINAL RESEARCH

Application of Dexmedetomidine Intravenously Infusion Before Induction of Anesthesia in Segmentectomy of Lung Cancer Patients

Lu Meng, MD; Youyang Hu, PhD

ABSTRACT

Objective • To study the application of dexmedetomidine in pulmonary segment resection in lung cancer patients.

Methods • A total of 120 patients with lung cancer who underwent segmentectomy in our hospital from January 2021 to January 2022 were selected and divided into a control group (60 cases) and a study group (60 cases) according to the lottery method. Early lung cancer was diagnosed by histopathology and imaging, which was in line with the indication of segmental pneumonectomy, and was not treated by radiotherapy, chemotherapy, and other means.Exclusion criteria: Patients with coagulation system diseases, middle and late-stage patients and distant metastasis were excluded. Before induction of anesthesia, the control group was injected with normal saline 0.6 μg/kg, and the study group was injected with dexmedetomidine 0.6 μg/kg. Before anesthesia induction (T0), ventilation for 0.5 h (T2), ventilation for 1 h (T2), and immediately after surgery (T3), the changes of hemodynamics, physiological stress, and internal environment stability indexes were analyzed, and adverse reactions and pulmonary symptoms were counted. Incidence of injury and cognitive impairment.

Results • The comparison of the observation indicators at T0 time point of the two patient groups was insignificant ($P > .05$). The T1-T3 point had no significant fluctuation in the study group compared with the T0 point ($P > .05$). The T1-T3 point in the control group was significantly higher than the T0 point MAP, HR, PaO_2, SOD, Cor decreased, $PaCO_2$, MDA, ACTH increased, with obvious fluctuations ($P < .05$); T1 ~ T3, compared with the control group, the study group MAP, HR, PaO_2, SOD, Cor increased, $PaCO_2$, MDA, ACTH decreased ($P < .05$). There was no significant comparison of adverse reactions between the two groups ($P > .05$). Compared with the control group, lung injury and cognitive impairment incidence in the study group was lower ($P < .05$).

Conclusion • Before anesthesia induction, intravenous injection of dexmedetomidine can maintain hemodynamic and internal environment stability in lung cancer patients, reduce stress damage to the body, and reduce the incidence of lung injury and cognitive impairment, with high application value. This will reduce the pain of patients in clinical. (*Altern Ther Health Med.* 2024;30(5):40-43).

Lu Meng, MD; Youyang Hu, PhD; Department of Anesthesiology, AnHui Chest Hospital, Hefei, Anhui, China.

Corresponding author: Youyang Hu, PhD
E-mail: youyanghu2022@163.com

INTRODUCTION

Lung cancer remains the leading cause of cancer mortality worldwide. There reported an estimated 388 000 lung cancer-related deaths in Europe in 2018, which was higher than those related to colorectal and breast cancer combined. Approximately 30 000 Canadians will be diagnosed with lung cancer, with a projection of 21 000 death in 2020. Globally, the cancer burden is projected to double by 2050, with lung cancer at the top of the list. At present, the incidence of lung cancer worldwide is increasing year by year. Segmental pneumonectomy is the most commonly used method for the treatment of early lung cancer. Intraoperative one lung ventilation can improve the safety and effectiveness of surgery.[1] Some studies have found that,[2] the affected side of the patient's lung is not ventilated during one lung ventilation, so it is very easy to lead to hypoxia and ischemia in this process, and blood flow reperfusion during subsequent re-expansion can promote the aggravation of lung injury to a certain extent.

Dexmedetomidine (DEX) is an intravenous α2a adrenergic receptor agonist widely used in intensive care units and in clinical anesthesia during surgery. According to the report,[3-4] safe and effective anesthesia is of great significance in reducing lung function, and dexmedetomidine is a kind of anesthesia α Receptor agonists have been widely used in the auxiliary of anesthesia because of their effects of inhibiting sympathetic nerve, sedation, and analgesia. Under

the above background, this study analyzed the effect of intravenous pump injection of dexmedetomidine before anesthesia induction in patients with lung cancer after segmental resection. It is reported as follows.

OBJECT AND METHOD

Research 0bject

Inclusion criteria: Early lung cancer was diagnosed by histopathology and imaging, which was in line with the indication of segmental pneumonectomy, and was not treated by radiotherapy, chemotherapy, and other means.

Exclusion criteria: Patients with coagulation system diseases; Middle and late-stage patients; Distant metastasis; Those who are allergic to narcotic drugs; Combined with malignant lesions in other parts; Major organ dysfunction or failure.

Method

After entering the operating room, the patients in both groups underwent routine venous access openin and connected to the monitor. Then we monitored vital signs, and monitored the bispectral index of EEG with an EEG activity detector. Before anesthesia induction, the control group was injected with normal saline intravenously 0.6 μg/kg, the study group was pumped with dexmedetomidine 0.6 μg/kg. Observe the bispectral index of EEG. If the bispectral index is lower than 55, intubate the trachea and implement mechanical ventilation. The respiratory ratio is 1:2, the respiratory rate is set to 10 ~ 12 times / min, the tidal volume is 6 ~ 8ml / kg, and end-tidal carbon dioxide (PETCO2) is maintained in the range of 30 ~ 40mmHg. After that, midazolam 0.03mg/kg, etomidate 0.5mg/kg, atracurium 0.8mg/kg and sufentanil 0.5 were injected intravenously μg/kg for anesthesia induction, pump vecuronium, remifentanil and propofol during operation to maintain anesthesia, stop pumping vecuronium and remifentanil 0.5h before the end of operation, and stop pumping propofol after skin suture.

Index Observation

Hemodynamic Index Monitoring. The changes of hemodynamic indexes, including mean arterial pressure (MAP), heart rate (HR), arterial oxygen partial pressure (PaO2), and arterial carbon dioxide partial pressure (PaCO2), were routinely monitored before anesthesia induction (T0), ventilation for 0.5h (T1), ventilation for 1H (T2) and immediately after operation (T3).

Evaluation of Physiological Stress and Internal Environmental Stability. 3 ml venous blood was collected at each time point, and the serum was obtained by centrifugation and stored at -80°C. The levels of stress indexes [superoxide dismutase (SOD), malondialdehyde (MDA)] and environmental indexes [cortisol (COR), adrenocorticotropic hormone (ACTH)] were measured by ELISA.

Statistical Analysis

Spss22.0 statistical software for analysis, the measurement data are described by $(\bar{x} \pm s)$, the comparison between the two groups adopts independent sample t test, and the comparison at each time point in the group adopts repeated measurement data for repeated measurement analysis of variance; The counting data were described by percentage and compared between groups χ^2test, $P < .05$ shows that the difference is statistically significant.

RESULTS

The information about patients in the study

1120 patients with lung cancer who underwent segmental pneumonectomy in AnHui Chest Hospital from January 2021 to January 2022 were divided into the control group (60 cases) and the study group (60 cases) by lot. The data of the two groups were balanced and comparable ($P > .05$), as shown in Table 1. The patients and their families gave informed consent to this study, signed the informed consent form, and obtained the approval of the ethics committee of our hospital.

Comparison of Hemodynamic Indexes Between the Two Groups

There was no significant difference between the two groups at T0 time point ($P > .05$); There was no significant fluctuation in each index of the study group from T1 to T3 compared with t0 ($P > .05$); Compared with T0 point, MAP, HR and PaO2 in T1 ~ T3 points of the control group decreased, $PaCO_2$ increased and fluctuated significantly ($P < .05$); At T1 ~ T3 points, compared with the control group, MAP, HR and PaO_2 increased and $PaCO_2$ decreased in the study group ($P < .05$). See Table 2 and Figure 1.

Table 1. Two sets of general information

	Control group (n = 60)	Study group (n = 60)	χ^2/t	*P* value
Gender (male/female)	34/26	30/30	0.536	.464
Average age (years)	41.23±4.56	41.87±4. 82	0.747	.456
BMI (kg/m^2)	23.89±1.12	23.74±1. 23	0.699	.486
ASA (Grade I./II.)	35/25	38/22	0.315	.575

Abbreviations: BMI, Body Mass Index; ASA, American Society of Anesthesiologists.

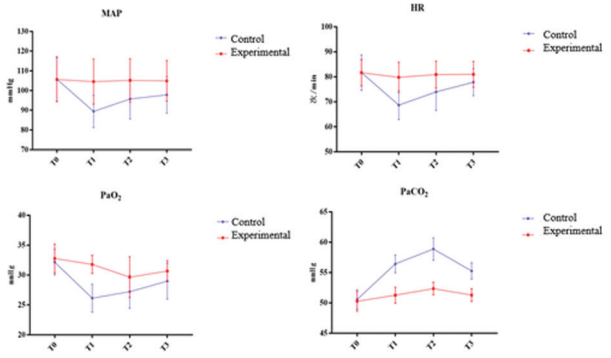
Table 2 Comparison of hemodynamic indicators between the two groups $(\bar{x} \pm s)$.

index	Point in time	Control group (n = 60)	Study group (n = 60)
MAP (mmHg)	T0	105.79±11.34	105.60±11.25
	T1	89.43±8.21[a]	104.53±11.47[b]
	T2	95.71±10.15[a]	105.11±11.02[b]
	T3	97.81±9.32[a]	104.89±10.32[b]
HR (/min)	T0	81.67±7.12	81.63±5.22
	T1	68.65±5.78[a]	79.75±6.12[b]
	T2	73.95±7.43[a]	80.89±5.43[b]
	T3	77.84±5.41[a]	80.98±5.19[b]
PaO_2 (mmHg)	T0	32.16±2.14	32.76±2.44
	T1	26.12±2.35[a]	31.78±1. 53[b]
	T2	27.21±2.78[a]	29.65±3. 41[b]
	T3	28.98±3.01[a]	30.66±1.76[b]
$PaCO_2$ (mmHg)	T0	50.56±1.62	50.26±1.63
	T1	56.43±1.47[a]	51.25±1.32[b]
	T2	58.87±1.86[a]	52.34±1.05[b]
	T3	55.25±1.35[a]	51.28±1.06[b]

[a] within the group T0 Point comparison $P < .05$
[b]Compared with the control group, $P < .05$

Abbreviations: MAP, mean arterial pressure; HR , heart rate; PaO_2, arterial oxygen partial pressure; $PaCO_2$, arterial carbon dioxide partial pressure.

Figure 1. Comparison of hemodynamic changes at each time point in the two groups



Comparison of physiological stress in the two groups

There was no significant difference between the two groups at T0 time point ($P > .05$); There was no significant fluctuation in each index of the study group at T1, T2 and T3 compared with T0 ($P > .05$); Compared with T0 point, SOD decreased and MDA increased at at T1, T2 and T3 points in the control group ($P < .05$); SOD increased and MDA decreased in the study group at at T1, T2 and T3 points, compared with the control group, ($P < .05$). See Table 3 and Figure 2.

Stability Analysis of the Internal Environment of Two Sets of Machines

There was no significant difference between the two groups at t0 time point ($P > .05$); There was no significant fluctuation in each index of the study group from T1 to T3 compared with t0 ($P > .05$); Compared with T0, cor decreased and ACTH increased at T1 ~ T3 points in the control group ($P < .05$); At T1 ~ T3 points, compared with the control group, cor increased and ACTH decreased in the study group ($P < .05$). See Table 4 and Figure 3.

Comparison of Adverse Reactions Between the two Groups

The number of patients in Nausea and vomiting in the control group was 1and 2 in the study group. Bradycardia, also known as bradycardia, is an important type of arrhythmia. In normal adults, the heart rate is between 60 and 100 beats per minute, and if it is less than 60 beats, it is called bradycardia. The number of patients in Bradycardia Chills in the control group was 0, and 1 in the study group. Hypotension is a condition in which the pressure in the arteries of the systemic circulation is lower than normal. The number of patients in Hypotension in the control group was 1, and 0 in the study group. The incidence of adverse reactions in the two groups was not meaningful ($P > .05$). See Table 5.

Comparison of the Incidence of Lung Injury and Cognitive Impairment between the Two Groups

Lung injury is usually due to an external force on the chest, or a direct or indirect violent injury to the chest. Cognitive disorders (CDs), also known as neurocognitive disorders (NCDs), are mental health disorders that primarily affect cognitive abilities, including learning, memory, perception, and problem solving. Compared with the control

Table 3 Comparison of physiological stress in the two groups ($\bar{x} \pm s$).

index	Point in time	Control group (n = 60)	Study group (n = 60)
SOD (nU/mL)	T0	96.12±11.42	96.34±12.91
	T1	84.85±9.23[a]	95.73±11.78[b]
	T2	76.71±6.12[a]	96.01±12.28[b]
	T3	81.64±8.66[a]	96.78±13.42[b]
MDA (mmol/L)	T0	3.01±0.41	3.08±0.45
	T1	5.74±1.26[a]	3.12±0.63[b]
	T2	7.53±1.11[a]	3.06±0.39[b]
	T3	4.33±0. 82[a]	3.11±0.51[b]

[a]with within the group T0 Point comparison, $P < .05$. [b]compared with the control group, $P < .05$.

Abbreviations: SOD, superoxide dismutase; MDA, malondialdehyde; COR, cortisol; ACTH, adrenocorticotropic hormone.

Figure 2 Comparison of physiological stress at each time point in the two groups

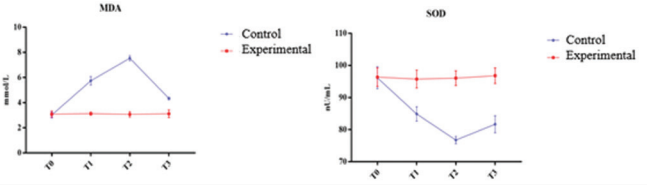


Table 4 Analysis of the stability of the environment in the two sets of airframes ($\bar{x} \pm s$).

index	Point in time	Control group (n = 60)	Study group (n = 60)
Heart(μg/L)	T0	218.96±16.35	219.25±17.45
	T1	196. 72±10.24[a]	218.96±18.27[b]
	T2	185.56±9.48[a]	220.13±22.19[b]
	T3	178. 55±5.32[a]	219.86±15.46[b]
ACTH (ng/L)	T0	33.68±1.65	33.72±1.62
	T1	37. 41±2. 66[a]	34.16±2.15[b]
	T2	44.25±1.82[a]	33.25±1.27[b]
	T3	53.17±6.76[a]	34.68±2.19[b]

[a]within the group T0 Point comparison, $P < .05$.
[b]compared with the control group, $P < .05$.

Abbreviations: ACTH, adrenocorticotropic hormone.

Figure 3 Comparison of the environmental stability in the airframe at each time point of the two groups

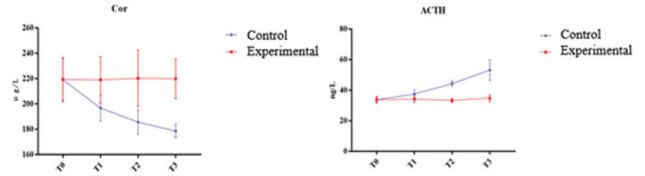


Table 5 Comparison of adverse reactions between the two groups [case (%)].

	Control group (n = 60)	Study group (n = 60)	χ^2	*P* value
Nausea and vomiting	1	2		
Bradycardia	0	1		
Chills	1	0		
Hypotension	1	1		
Total incidence	3 (5.00)	4 (6.67)	0.152	.700

Table 6. Comparison of lung injury and cognitive impairment incidence between the two groups [case (%)].

	Control group (n = 60)	Study group (n = 60)	χ^2	*P* value
Incidence of lung injury	7 (11.67)	1 (1.67)	4.821	.028
Incidence of cognitive impairment	8 (13.33)	2 (3.33)	3.927	.048

group, lung injury and cognitive impairment incidence in the study group was lower ($P < .05$). See table 6.

DISCUSSION

Unilateral ventilation is used during segmental pneumonectomy, which will increase intrapulmonary shunt. After ventilation, the patient's pulmonary ventilation function will return to normal. At this time, it will lead to the secretion of a large number of oxygen free radicals, leading to physiological stress and lung injury.[5] With the continuous research on dexmedetomidine,[6-7] it not only has the effect of auxiliary anesthesia, but also has the effect of organ protection. Dexmedetomidine exerts sedative, analgesic, anti-anxiety, sympathetic inhibition and organ protection effects by acting on different α2 adrenergic receptors, in which the medulla bulbar and locus coeruleus located in the brain stem are important targets. Studies suggest that dexmedetomidine is activated in the central nervous systemα. The locus coeruleus of the brain stem with a dense distribution of 2 receptors plays a sedative and anesthetic role.[8] According to the report,[9] dexmedetomidine has great advantages in maintaining hemodynamics and internal environment stability. The results of this paper show that compared with the control group, the hemodynamic related indexes map, HR, PaO_2 and $PaCO_2$ of the study group injected with dexmedetomidine intravenously before anesthesia induction fluctuate less and are relatively stable at each time point. This result shows that dexmedetomidine has an ideal effect in stabilizing the hemodynamics of lung cancer patients after segmental pneumonectomy, which is consistent with the results of Fang Wen et al.[10]

Under external stimulation such as surgery and anesthesia, patients have dysfunction of the oxidation-oxidation system, and the imbalance of redox balance in the body is related to the degree of stress. The occurrence of dysfunction of the oxidation-oxidation system mostly marks the oxidative stress injury of patients, which is manifested in the decrease of SOD and the increase of MDA.[11-13] In addition, it is reported that,[14-15] for surgical patients, there will be a certain degree of disorder in the internal environment during anesthesia. Clinically, the changes in cor and ACTH levels are often used to evaluate the changes in the internal environment of patients. COR is one of the members of steroid glucocorticoids and comes from the adrenal cortex. ACTH can control its level. When it increases, it indicates that the patient has various stress states and internal environment disorders.[16-17] This paper analyzes the patients' physiological stress and internal environment stability at different time points. The results show that there is no significant fluctuation in the indexes of physiological stress and internal environment stability at each time point in the study group, while the fluctuation is more obvious in the control group. This result shows that the intravenous injection of dexmedetomidine before anesthesia induction will not greatly impact the patients' internal environment and can maintain the stability of the internal environment.

A study shows that,[18-20] dexmedetomidine intervention during one lung ventilation in elderly patients with lung cancer can effectively reduce the risk of lung injury. This paper also proves this view. In addition, this study analyzes the occurrence of cognitive impairment in the two groups and shows that the incidence of cognitive impairment in the study group is significantly reduced. The dexmedetomidine can also reduce cognitive impairment and promote postoperative recovery on the basis of ensuring the stability of hemodynamics and the internal environment. However, there are also disadvantages in this study. The number of patients was not enough, which might cause potential sources of bias, confounding variables. Also, the mechanism of this study was not explained. Further studies still need to explore the underlying mechanism of how dexmedetomidine exert its effect.

In conclusion, intravenous infusion of dexmedetomidine before anesthesia induction in patients with lung cancer after segmental resection can maintain the stability of hemodynamics and internal environment, reduce stress injury to the body, reduce the incidence of lung injury and cognitive impairment, and has high application value. Therefor, the anesthesiologists or healthcare providers and use intravenous infusion of dexmedetomidine to redue pain of lung cancer patients.

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