Effects of sevoflurane and dexmedetomidine on patient awakening quality during thoracoscopy for the treatment of radical lung cancer

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Introduction. To investigate the application of sevoflurane and dexmedetomidine in thoracoscopic radical resection of lung cancer and effect on awakening quality.

Methods. A total of eighty patients were randomly assigned to the SD group (sevoflurane and dexmedetomidine were used to induce general anesthesia, n=40) and the TGA group (traditional general anesthesia, n =40). The dosage of anesthetic drugs, the time of awakening, peripheral capillary oxygen saturation(SPO_2), and the visual analogue scale (VAS) at 2 and 6 hours postoperatively were recorded. Additionally, the mean arterial pressure (MAP) and heart rate (HR) at each time point of preoperative (T0), induction of anesthesia (T1), cutaneous (T2), and awakening from anesthesia (T3) were observed.

Results. There were statistically significant differences in MAP and HR between the two groups ($P<0.05$). The VAS score in the SD group was lower than that in the TGA group ($P<0.05$), and the dosage of propofol, remifentanil, and sufentanil was lower and the awakening time was shorter in the SD group ($P<0.05$).

Conclusion. The use of sevoflurane combined with dexmedetomidine anesthesia can enhance the anesthetic effect while simultaneously reducing the amount of anesthetic drugs and time needed to awaken from the anesthetic.

Keywords. Anesthesia; Lung Cancer; Sevoflurane; Dexmedetomidine

1. INTRODUCTION

At present, lung cancer is one of the leading causes of illness and mortality in both men and women all over the world. The disease presents with a subdued phenotype at first, which is followed by the development of a persistent tumor. The non-small cell lung cancer (NSCLC) is the most prevalent form of lung cancer, making up 85 percent of all lung cancers (1). In this age of personalized medicine, molecular targeted therapy for lung cancer has had a great deal of success; yet, its effectiveness has been hampered by the prevalence of resistance mechanisms (2). Lung cancer is by

far the most prevalent cause of superior vena cava syndrome, and the majority of instances of superior vena cava (SVC) are caused by tumors (such as NSCLC, small cell lung cancer, malignant lymphoma, and so on). External compression, direct invasion, internal thrombosis, or embolism of the SVC can all lead to symptoms of SVC syndrome (3) (4).

For patients with resectable lung cancer, the surgical treatment process needs to be performed under general anesthesia. However, general anesthesia can lead to some adverse reactions in patients during surgery, including stress reactions, allergic reactions to anesthetic drugs, and significant changes in hemodynamics. Even in severe cases, patients may experience reduced cerebral oxygen saturation, hypoxemia that endangers their lives, and is not conducive to postoperative recovery (5; 6). In the effort to find a sevoflurane dose-saving strategy, dexmedetomidine was evaluated as a potential relief medication (7). When combined, dexmedetomidine and sevoflurane have a wide variety of benefits (8). These effects include the ability to lower the risk of restlessness in children undergoing eye surgery more effectively than other drugs (9). In addition, patients undergoing laparoscopic cholecystectomy who receive general anesthesia with dexmedetomidine mixed with propofol experience a reduction in visual analog score for pain and Aldrete's score as well as an improvement in the quality of their postoperative recovery (10). Dexmedetomidine has also been shown to effectively assist sevoflurane anesthesia during surgical embolization of intracranial aneurysms (11). This helps to reduce the amount of time it takes for the patient to regain consciousness and be extubated, as well as the amount of stress and energy metabolism, which stabilizes hemodynamic parameters, reduces adverse effects, and stabilizes hemodynamic parameters, thereby reducing damage to the central nervous system (12).

The purpose of this manuscript is to investigate the possibility of using sevoflurane and dexmedetomidine in conjunction with a thoracoscopic radical therapy of lung cancer, as well as the impact of such a treatment on the patient's level of consciousness after the procedure.

2. MATERIALS AND METHODS

2.1 Clinical Sample Collection: Eighty patients who were admitted to Nanfang Hospital between February 2020 and September 2021 for elective thoracoscopic radical lung cancer surgery were studied. By the random number table method, all patients were split into two groups: the SD group

(sevoflurane and dexmedetomidine were used to induce general anesthesia, n=40) and the TGA group (traditional general anesthesia, n =40). As can be shown in Table 1, there were no statistically significant differences the SD group and the TGA group in terms of gender, age, body mass index, ASA categorization, and operation time. Written consent was obtained from the local Ethics Committee or Institutional Review Board. All of the patients involved provided their informed consent and completed the appropriate paperwork.

All of the patients had a single lung lobectomy, and their ASA grades ranged from I to II. Those patients who had a combined infection at the puncture site, those patients who had abnormal coagulation, those patients who had hypertension, those patients who had psychiatric disorders, those patients who were addicted to drugs, and those patients who had organ dysfunction such as heart, lung, liver, or kidney were excluded. Before undergoing surgery, each patient was instructed to refrain from eating for 12 hours and drinking for 8 hours, and none of them utilized any medicines. After being taken into the operating room, the patient underwent monitoring with an electrocardiogram, invasive arterial blood pressure, and central venous pressure.

2.2 Experimental groupings: Sevoflurane and dexmedetomidine were used in conjunction with each other to achieve EG. After positioning the patient on the healthy side, sterilizing them, and toweling them off, an ultrasound probe was positioned in the sagittal position next to the thoracic 5 vertebral body, then moved to 2.5 cm next to the median line, where imaging of the transverse process and the vertical spinal muscles were visible, then the ultrasound probe was adjusted to be located just above the transverse process, and using an out-of-plane technique, a puncture needle was inserted in the median v space using (AstraZeneca AB, approval number: H20140763). At a time range of 20 to 25 minutes, the wet swab approach provided accurate measurements of the block.

Cis-atracurium 0.15 mg/kg (Jiangsu Hengrui Pharmaceutical Co., Ltd., State Drug Quasi-Zi H20060869), midazolam 0.05 mg/kg (Jiangsu Enhua Pharmaceutical Co., Ltd., State Drug Quasi-Zi), and propofol 4-8 mg/kg (Beijing Fresenius Kabi Pharmaceutical Co., Ltd., State Drug Quasi). To produce anesthesia, Dazolam 0.05 mg/kg (Jiangsu Enhua Pharmaceutical Co., Ltd., State Drug Quasi-Zi H19990027) was administered. Following this, a double-lumen bronchial catheter was placed, and fiberoptic bronchoscopic alignment was performed. Propofol was administered at a rate of 4-8 mg/(kg-h), and remifentanil was administered at 0.1-0.5 g/(kg-min) (Yichang Renfu

Pharmaceutical Co., Ltd., State Drug Quantifier H20030197), and cis-atracurium was administered at 5 mg/h. Anesthesia was kept going throughout the procedure. Intravenous analgesic pumps were installed postoperatively and programmed with 3 micrograms per kilogram of sufentanil, 150 milligrams of kefen (Beijing Tide Pharmaceutical Co., Ltd., State Drug Quantifier H20041508), and 15 milligrams of toltestrone (Shandong Luoxin Pharmaceutical Co., Ltd., State Drug Quantifier H20061060), all of which were diluted to 100 milliliters with. The TGA group was anesthetized with isoflurane and midazolam.

2.3 Indicators: The dosage of anesthetic drugs such as propofol, sufentanil, and remifentanil, the time required to awaken, and the SPO_2 and VAS scores at 2 h and 6 h postoperatively were observed in the two groups before surgery (T0), at the induction of anesthesia (T1), skin incision (T2), and awakening from anesthesia. Additionally, the SPO_2 and VAS scores were compared at each time point (T3)

Both the mean arterial blood pressure and the mean heart rate were recorded at each time point.

2.4 Statistical methods: SPSS 22.0 statistical software was used for data analysis, and the count data were expressed as (n (%)), and the comparison between groups was done using a chi-square test. Measurement data were expressed as mean and standard deviation or median and interquartile range(IQR) as appropriate. If the data conforms to the normal distribution, a t-test was used to analyze the differences within groups, and ANOVA was used for repeated measures data. Differences were considered statistically significant at $P < 0.05$.

3. RESULTS

3.1 Hemodynamic parameters between the two groups:There was no statistically significant difference in the comparison of MAP and HR between the SD group and the TGA group at the moment of T0, while statistically difference at T1, T2, and T3 as determined by repeated measurement ANOVA ($P <0.05$). The MAP and HR measurement values of the two groups changed throughout the study ($P <0.05$). In Table 2, there was a statistically significant interaction effect between the effect of the type of anesthesia and the effect of the change in time ($P <0.05$).

3.2 Comparison of the dosage of each anesthetic drug between the two groups: Intraoperative propofol, remifentanil, and sufentanil dosages were significantly less in the SD group than in the

TGA group ($P < 0.05$), as shown in Table 3.

3.3 Comparison of awakening time: Scores on the SPO_2 and the VAS were comparable between the SD group and the TGA group. As can be seen in Table 4, the awakening time in the SD group was significantly shorter than that of the TGA group. Additionally, the SPO_2 index at 2 and 6 h postoperatively was significantly higher than that of the TGA group, while the VAS score was significantly lower than that of the TGA group ($P< 0.05$).

4. DISCUSSION

NSCLC, accounts for the majority of lung cancer occurrences because lung cancer (LC) is the leading cause of cancer-related deaths worldwide (13). Pain is one of the most dreaded symptoms of illness, and it is something that human beings have been attempting relentlessly to alleviate and overcome since the beginning of time. Patients who have advanced NSCLC usually experience challenges when attempting to receive targeted therapy due to the development of drug resistance and increasing levels of pain. NSCLC is characterized by high incidence rate, rapid progression, and high mortality (14). In principle, it is based on the clinical stage of lung cancer, improves various examinations, and has surgical adaptation. Patients with acute respiratory syndrome should be treated with surgery in time. With the continuous development of minimally invasive technology, video-assisted thoracoscopic lobectomy is more and more widely used, and can achieve better therapeutic effects (15). However, for elderly patients with lung cancer, there is a greater risk of anesthesia (16). Poor anesthesia induction leads to poor quality of postoperative awakening, increasing postoperative cognitive impairment risk, and reducing the quality of life of patients. Some studies have pointed out that giving a reasonably compatible anesthetic program during anesthesia induction is conducive to reducing cognitive dysfunction (17; 18). Most anesthetics can reduce the overall oxygen metabolism of the brain. For the elderly patients, their brain cells are gradually declining and the aging process of brain cells can worsen their brain function after the use of anesthesia. The utilization of anesthetic drugs is a significant factor contributing to postoperative cognitive impairment. Therefore, it is imperative to choose appropriate anesthetic drugs for elderly lung cancer patients to minimize the risk of adverse reactions after general anesthesia. (19; 20).

In our attempt to create a more effective anesthetic, we included both sevoflurane and

dexmedetomidine in the paper. This was carried out in order to shorten the length of time necessary for the patient to recover from the anesthesia following the surgical procedure, make use of a lower total quantity of anesthetic medicines, and guarantee a very high level of safety. Because of this, the anesthetic effect was enhanced, and the patient experienced significantly less pain as a result.

Dexmedetomidine, also known by its acronym DMED, is a highly selective alpha-adrenoceptor agonist. It is frequently employed for the purposes of sedation, analgesia, and the administration of stress management (21; 22).

Additionally, dexmedetomidine had a potent inhibitory effect on the up-regulation of hypoxia-inducible factor 1a at the level of the mRNA as well as the protein. By genetically suppressing the expression of hypoxia-inducible factor 1, it is feasible to reverse the anti-inflammatory effects of dexmedetomidine (23). In addition, the duration of the effect of dexmedetomidine is shorter than that of clonidine, and it binds to alpha-2 receptors in a thermal manner that is eight times more thermally stable than clonidine (24). Dexmedetomidine is a medicine that, when taken with several other types of local anesthetics, has the potential to increase the efficacy of such anesthetics without creating an increase in the frequency of the anesthetics' undesirable side effects. It has been shown through research that the administration of sevoflurane for pediatric anesthesia is an essential component of the surgical process. In the context of medical practice, various other anesthetic adjuvants may be utilized in conjunction with sevoflurane to accomplish a variety of tasks and reduce the amount of time it takes for the patient to emerge from the induced state of unconsciousness brought on by the anesthesia (25).

Limitation:On the one hand, our experimental findings contain a few caveats and will be followed by research with larger participant pools in order to better provide robust evidence for clinical application. On the other hand, despite the fact that dexmedetomidine is only approved for intravenous use at the moment, it has been successfully used in both experimental and clinical studies for the purpose of neuraxial blockade without causing any neurological deficits, which encourages its use through the epidural route. Despite this, there are some doubts about whether or not it is safe to use. It is necessary to conduct research using dexmedetomidine as a TGA group in order to determine the potential local effect of dexmedetomidine, which will make the results of our experiment more accurate.

5. CONCLUSION

The utilization of sevoflurane in combination with dexmedetomidine anesthesia has the ability to enhance the anesthetic effect while simultaneously reducing the amount of anesthetic drugs required and the time needed for patients to recover consciousness. The combination of sevoflurane with dexmedetomidine anesthesia can improve the quality of awakening in patients undergoing thoracoscopic radical resection for lung cancer.

DECLARATION

Declaration of conflicting interests

All authors declared that no conflicts of interest in this study.

DATA AVAILABILITY STATEMENT

The data used to support the findings of this study are readily available from the corresponding author.

FUNDING STATEMENT

We haven't received any funding. None

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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AUTHORS CONTRIBUTIONS

All authors contributed significantly to this study. Yinzhen Zeng and Nan Sun designed the trialand conducted the work and are involved in data collection. Yinzhen Zeng a nalyzed the data. Yinzhen Zeng

and Nan Sun interpreted the data. Yinzhen Zeng and Nan Sun wrote and revised the manuscript.

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TABLES

Table 1 Comparison of clinical data between the SD group and the TGA group

Groups	Gender (M/F)	Age (years)	Body mass index (kg/m^2)	ASA classification (I//II)	Operating time (min)
SD group	23/17	57.12±6.13	24.32±2.51	20/20	179.32±27.86
TGA group	18/22	56.64±10.23	23.95±2.33	19/21	184.66±31.73
t/χ^2	1.251	0.255	0.697	0.201	0.800
P-value	0.263	0.800	0.488	0.654	0.426

Table 2 Comparison of heart rate and mean arterial blood pressure ($\bar{x}$±s)

Groups	MAP (mmHg)				HR (times/min)			
	T0	T1	T2	T3	T0	T1	T2	T3
SD group (n=40)	96.5±5.4	92.4±5.0	91.7±7.0	95.6±6.7	77.6±8.3	73.3±6.5	72.9±8.8	78.9±6.6
TGA group(n=40)	97.2±6.1	87.3±6.0	86.9±6.5	97.3±5.5	78.1±8.2	68.1±7.8	66.3±8.3	83.7±7.2
F (intergroup/time/interaction)	16.457/23.257/14.354				15.833/23.547/13.442			
P-value (between groups/time/interaction)	< 0.001/ < 0.001/ < 0.001				< 0.001/ < 0.001/ < 0.001			

Table 3. Comparison of the dosage of each anesthetic drug ($\bar{x}$±s)

Groups	Propofol (mg)	Rifentanil (μg)	Sufentanil (μg)
SD group	864.2±23.5	1501.7±134.5	25.0±6.8
TGA group	1550.4±14.3	2248.6±164.7	37.0±4.2
t	157.764	22.215	9.496
P	< 0.001	< 0.001	< 0.001

Table 4 Comparison of awakening time, SPO_2, and VAS scores ($\bar{x}$±s)

Groups	Wake up time (h)	SPO_2 (%)		VAS (points)	
		2h	6h	2h	6h
SD group	12.4±2.1	95.43±1.50	95.95±1.41	1.06±0.62	1.22±0.57
TGA group	17.9±4.5	94.20±1.41	94.77±1.52	3.25±0.70	2.69±0.64
t	7.005	3.779	3.560	14.812	10.848
P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001