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Observation of the clinical efficacy of dexmedetomidine in flexible bronchoscopy under general anesthesia: clinical case experience exchange

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Abstract

Object: To investigate the clinical efficacy and safety of dexmedetomidine in flexible bronchoscopy under general anesthesia.

Methods: A total of 114 patients were randomly divided into intervention group A and control group B. Group A received dexmedetomidine, fentanyl, and propofol as anesthesia, while Group B received fentanyl and propofol only. Changes in heart rate, mean arterial pressure, pulse oxygen saturation, stress indices (blood cortisol, adrenaline, and norepinephrine levels), incidence of adverse events, anesthesia dose, duration of procedure, and recovery time were compared between the groups at specific time points T0, T1, and T2 during bronchoscopy.

Results: There was no statistical difference between the groups at T0. At T1 and T2, pulse oxygen saturation, mean arterial pressure, heart rate, and stress indices in group A were significantly more favorable than those in group B. The incidence of adverse events (5.26%) in group A was significantly lower than that in group B (17.54%), and patients in group A required less propofol and had a faster recovery time than patients in group B.

Conclusion: Dexmedetomidine use in flexible bronchoscopy under general anesthesia is safe and effective and decreases the stress response in synergy with propofol to provide hemodynamic stability.

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Introduction

Flexible bronchoscopy under general anesthesia is a technique commonly used in respiratory medicine to directly observe the morphology, location, and extent of tracheal and bronchial lesions, as well as for performing biopsies and cytological examination.[1] Compared with traditional methods, flexible bronchoscopy has advantages including increased safety, increased brightness, clearer vision, and increased patient comfort and satisfaction, meaning that the procedure is increasingly being used in clinical practice.[2] At present, pain-free electronic bronchoscopy requires general anesthesia with a laryngeal mask. However, if the depth of anesthesia is not sufficiently controlled during bronchoscopy, patients may experience strong irritative reactions and even cardiovascular events that can hinder the treatment process.[3] Therefore, strategies to improve the quality of electronic bronchoscopy and promote comfortable medical treatment are of increasing interest in clinical research.[4] In the present study, dexmedetomidine combined with fentanyl and propofol for general anesthesia using a laryngeal mask was used to perform painless flexible bronchoscopy in patients at our hospital.

Materials and methods

General information

Case data were obtained for patients who underwent bronchoscopy at our hospital from March 2017 to October 2018. Patients with unexplained hemoptysis, obstructive pneumonia, or pulmonary mass; scheduled for bronchial foreign body removal; and with American Society of Anesthesiologists (ASA) grade I–III status were eligible for inclusion in the study.[5] The exclusion criteria were as follows: severe respiratory and cardiac dysfunction; serious diseases such as infection, organ failure, or heart disease; confirmed or suspected history or family history of malignant hyperthermia; pregnancy or lactation; and long-term use of opioid or benzodiazepine sedatives. The study protocol was approved by the Ethics Committee of Linyi(linzi) District People's Hospital of Zibo City, and written informed consent was obtained from each patient prior to participation.

Bronchoscopy method

Patient cardiopulmonary, hepatic, and renal functions were fully evaluated prior to bronchoscopy. Hypertensive patients continued to receive their routine antihypertensive medication, while patients with diabetes discontinued hypoglycemic medication on the day of the procedure and instead received insulin according to blood glucose levels during the examination. Any use of bronchodilator medications was discontinued. Patients fasted for 6 to 8 hours before the procedure, with no liquid intake for the final 2 hours. Patients in group B received fentanyl and propofol for general anesthesia with a laryngeal mask while those in group A received

dexmedetomidine, fentanyl, and propofol. Following catheter placement in an upper-limb peripheral vein, blood pressure, pulse, respiration and oxygen saturation (SpO_2) were routinely monitored. Patients in group B were pre-administered 50 mL of placebo saline, while those in group A were pre-administered 50 mL of saline plus 40 μg dexmedetomidine (0.5–1 μg/kg). Both groups received intravenous fentanyl 2 to 4 μg/kg and propofol 1.5 to 2 mg/kg within 1 to 1.5 minutes, followed by atracurium injection 0.3 to 0.6 mg/kg after loss of consciousness. Next, a laryngeal mask was applied and used to continuously deliver propofol and fentanyl to maintain anesthesia. The initial and total dose of propofol and fentanyl, duration of procedure, and recovery time (Aldrete's recovery score > 9) were recorded. Next, the grille at the front of the laryngeal mask was carefully cut and a small amount of water-soluble lubricant was applied to the back of the mask to prevent it from drying out. After reaching the target position, one end of the Y-joint was connected to the anesthesia system while the other end was used to allow the bronchoscope to pass through the laryngeal mask for ventilation control. Blood oxygen saturation was closely observed during the procedure. When the value was $<90\%$, the bronchoscope was withdrawn and assisted breathing applied until SpO_2 was restored prior to proceeding with the examination. Propofol was intravenously injected at 1.5 to 2 mg/kg and then continuously pumped at 4 mg/kg/hour. Fentanyl was used for anesthesia maintenance at 0.1 to 1 μg/kg/minute. The pump dosage of propofol and fentanyl was adjusted according to the patient's blood pressure, heart rate, and body movement. When the examination was complete, pumping was discontinued and the laryngeal mask removed when the vital signs were stable and the patient displayed spontaneous breathing and consciousness recovery.

Observation indicators

Mean arterial pressure (MAP), heart rate (HR), and SpO_2 were recorded prior to bronchoscope insertion (T0), at bronchoscopy through the glottis and trachea (T1), and at bronchoscope removal (T2). Change in SpO_2 and the incidence of adverse events during the examination, including cough, belching, throat problems, mucus, involuntary movement, and abnormal blood pressure were recorded. Stress response indicators were observed at T0, T1, and T2, and blood cortisol (Cor), adrenaline (E), and norepinephrine (NE) levels were determined by radioimmunoassay with sensitivity 1 μg/L (Beijing Beidong Dongya Biotechnology Research Institute, Beijing, China). The total duration of the procedure; total dose of propofol, fentanyl, and atracurium; and patient recovery time were also recorded.

Statistical processing

Statistical analysis was performed using SPSS 19.0 statistical software (SPSS Inc. Chicago, IL, USA). Measurement data were expressed as mean ± standard deviation ($\bar{\chi} \pm s$) and count data were analyzed by χ^2 test. Between-group comparisons were performed using an independent sample t test, while within-group comparisons were performed using a paired sample t test. Values of $P < 0.05$ were considered statistically significant.

Results

Patient characteristics

In total, 114 patients were eligible for inclusion and were randomized to group A (intervention group) and group B (control group) using a random number table method. Group A included 32 men and 25 women with a mean age of 58.2 ± 4.6 years (range: 42–86 years) and mean body weight

Table 1. General information comparison.

Group	Cases	Gender (%)	Age (years)	Weight (kg)
A	57	Male 32 (56.1) Female 25 (43.9)	58.2 ± 4.6	62.4 ± 5.8
B	57	Male 38 (66.7) Female 19 (33.3)	58.4 ± 4.3	62.1 ± 5.4

Table 2. Evaluation and comparison of intraoperative parameters between the two groups (n = 57).

Index	Group	T0	T1	T2
SpO_2 (%)	Group A	97.57 ± 2.5	97.6 ± 2.1	97.1 ± 2.6
	Group B	97.3 ± 2.6	93.3 ± 1.5$^{\triangle}$	94.4 ± 1.7$^{\triangle}$
	t/P	0.419, >0.05	12.580, <0.01	6.562, <0.01
MAP (cm H_2O)	Group A	80.2 ± 6.5	81.4 ± 5.6	80.1 ± 4.5
	Group B	81.3 ± 5.3	92.3 ± 4.9$^{\triangle}$	83.3 ± 5.1$^{\triangle}$
	t/P	0.990, >0.05	11.059,<0.01	3.552, <0.01
HR (times/minute)	Group A	66.4 ± 8.7	55.4 ± 9.3	62.5 ± 5.6
	Group B	66.3 ± 8.6	70.4 ± 6.2$^{\triangle}$	75.6 ± 7.3$^{\triangle}$
	t/P	0.062, >0.05	4.053, <0.01	10.750, <0.01

Compared with T0 $^{\triangle}$ P<0.05. SpO_2, oxygen saturation; MAP, mean arterial pressure; HR, heart rate.

of 62.4 ± 5.8 kg (range: 48–75 kg). Group B included 38 men and 19 women with a mean age of 58.4 ± 4.3 years (range: 45–85 years) and mean body weight of 62.1 ± 5.4 kg (range: 46–75 kg). There were no significant differences in baseline data (gender, age, and weight) between the two groups (Table 1).

Intraoperative parameters of the two groups

There were no statistically significant differences in the intraoperative parameters between the two groups at T0. At T1 and T2, the SpO_2, MAP, and HR values for group A were significantly different compared with those for group B ($P < 0.05$). Furthermore, in group B, significant differences in SpO_2, MAP, and HR were observed between each of the three time points ($P < 0.05$, Table 2). Vital signs remained stable in all patients in both groups during the procedure.

Changes in intraoperative stress in the two groups

There were no statistically significant differences in the indicators of intraoperative stress between the two groups at T0. At T1 and T2, however, the levels of Cor, E, and NE in group A were significantly lower than those in the control group ($P < 0.05$). Within group B, there were significant differences in the levels of E and NE at T1 and T2 compared with T0 ($P < 0.05$, Table 3).

Incidence of adverse reactions during surgery in both groups

The incidence of adverse events during the procedure was significantly lower in group A than in group B (Table 4).

Drug use and recovery time in the two groups of patients

There was no significant difference between the groups in the duration of the procedure

Table 3. Comparison of changes in intraoperative stress between the two groups (n = 57, ng/mL).

Index	Group	T0	T1	T2
Cor	Group A	98.80 ± 34.20	102.00 ± 32.55	100.20 ± 30.20
	Group B	99.50 ± 30.60	180.90 ± 30.24△	134.00 ± 29.89△
	t/P	0.419, >0.05	13.407, <0.01	6.006, <0.01
E	Group A	2.45 ± 0.15	2.54 ± 0.16	2.47 ± 0.17
	Group B	2.50 ± 0.14	3.56 ± 0.15△	2.87 ± 0.15△
	t/P	0.990, >0.05	35.113, <0.01	13.320, <0.01
NE	Group A	3.68 ± 0.14	4.47 ± 0.15	4.10 ± 0.16
	Group B	3.60 ± 0.16	4.56 ± 0.16△	4.30 ± 0.15△
	t/P	0.062, >0.05	3.098, <0.01	6.885, <0.01

Compared with T0 △ P<0.05. Cor, cortisol; E, adrenaline; NE, norepinephrine.

Table 4. Comparison of the incidence of adverse events between the two groups [n = 57, case (%)].

Group	Cough	Belching	Mucus	Body motion	Throat problems	Abnormal blood pressure	Total
Group A	1 (1.75)	1 (1.75)	0 (0.00)	1 (1.75)	0 (0.00)	0 (0.00)	3 (5.26)
Group B	2 (3.51)	2 (3.51)	1 (1.75)	2 (3.51)	1 (1.75)	2 (3.51)	10 (17.54)
χ^2							7.465
P							<0.05

or the initial dose of propofol, fentanyl, or atracurium. However, the total amount of propofol in group A was significantly lower than that in group B (130 ± 60 mg vs. 150 ± 100 mg; $P < 0.05$), and the recovery time in group A was significantly shorter than that in group B (10 ± 3 minutes vs. 12 ± 5 minutes; $P < 0.05$). There was no significant difference in the total dose of fentanyl between the two groups.

Discussion

Bronchoscopy is a commonly used procedure in the diagnosis and treatment of clinical respiratory conditions and plays an important auxiliary role in the diagnosis and treatment of various diseases, permitting a clear and intuitive observation of changes in bronchial tissues to facilitate diagnosis. Furthermore, appropriate medication can be delivered during the procedure and tissue biopsy can be performed.[6,7] In the context of patient safety and acceptability, flexible bronchoscopy under general anesthesia is associated with reduced trauma, fewer adverse effects, and greater advantages compared with traditional bronchoscopy. Flexible bronchoscopy is therefore becoming more widely used in clinical practice, although it remains an invasive detection method that can cause adverse reactions such as cough, abnormal blood pressure, and bronchospasm, and some patients lack an appropriate understanding of the procedure. Negative emotions such as fear and tension are frequency experienced by patients during the procedure, and it is more likely to be painful, which limits patient acceptability and can hinder diagnosis and treatment.[8]

At present, most anesthetic methods for painless bronchoscopy involve general anesthesia using a laryngeal mask.[9]

However, when an instrument passes through the glottis and trachea, the depth of anesthesia may not be well controlled, resulting in severe coughing and agitation, interrupting the examination, as well as complications such as respiratory depression and decreased oxygen saturation. Patient safety and observation of the surgical method may thus need to be considered during the procedure to avoid cardiovascular and cerebrovascular accidents.

Dexmedetomidine is a novel highly selective α2 adrenergic receptor agonist with good pharmacological properties of analgesia, sedation, inhibition of anxiety and inhibition of sympathetic nerve activity. Previous studies have shown that dexmedetomidine can attenuate multiple stimuli including circulatory kinetics during general anesthesia intubation and airway response during general anesthesia to maintain stable perioperative blood flow, thus ensuring optimal perioperative conditions.[10–12] Cortisol, a glucocorticoid secreted by the adrenal cortex, is a sensitive indicator of the body's stress response, while a rapid increase in plasma concentrations of adrenaline and norepinephrine is a major manifestation of sympathetic-adrenal medullary system activation. Therefore, the monitoring of sympathetic hormones and cortisol can allow perioperative stress response in a timely manner.[13]

As a new type of airway, the laryngeal mask is easy to position and operate. It is suitable for use in patients with chronic cardiovascular disease and is associated with minimal damage to the respiratory tract and improved efficiency of examination.[14]

All patients received propofol and fentanyl for flexible bronchoscopy under general anesthesia in the present study, while group A also received dexmedetomidine. There was no statistically significant difference between the two groups at T0. At T1 and T2, SpO_2, MAP, HR, and the stress indicators Cor, E, and NE were more stable and significantly better in group A than in group B. Furthermore, the incidence of adverse events in group A was significantly lower than that in group B. Taken together, these findings indicate that dexmedetomidine combined with propofol and fentanyl for flexible bronchoscopy under general anesthesia can stabilize the vital signs; inhibit the body's stress response, especially the response to electronic bronchoscopy; and reduce the occurrence of adverse events compared with the use of propofol and fentanyl alone. These findings may be attributable to the ability of dexmedetomidine to selectively inhibit the activation of the central nervous system and peripheral α2 adrenergic receptors, which reduce sympathetic nerve activity and abnormally increase blood pressure and heart rate under stress to maintain hemodynamic stability.[15] Riachy et al.[15] previously reported a comparison of dexmedetomidine with other sedation regimens and proposed a protocol as a first step towards standardizing sedation practices in flexible bronchoscopy, which may be adopted in further studies to optimize treatment strategies.

In the present study, propofol combined with fentanyl was used for adequate anesthesia as they are the most commonly used anesthetics for painless endoscopy. Both agents are widely used in clinical anesthesia and have the advantages of fewer side effects, high controllability, and rapid recovery after surgery.[15] The levels of SpO_2, MAP, and HR in group B differed significantly between T1, T2, and T0 ($P < 0.05$), indicating that increased irritation at T1 and T2 during electronic bronchoscopy requires more anesthesia. Patients in group A were pre-administered dexmedetomidine to optimize anesthesia, allowing the endoscopist to perform a more detailed examination, conducive to an accurate diagnosis.

In summary, dexmedetomidine combined with propofol and fentanyl for

flexible bronchoscopy under general anesthesia with laryngeal mask is a feasible strategy for anesthesia that stabilizes the vital signs with a low stress response. Dexmedetomidine has a synergistic effect with propofol, which is safe and reliable and associated with rapid recovery from surgery. This combination strategy for anesthesia reduces procedural pain, thus increasing patient acceptability, while facilitating a more detailed and accurate clinical diagnosis and successful follow-up treatment.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Ethical disclosures

The study protocol was approved by the Ethics Committee of Linyi(linzi) District People's Hospital of Zibo City, and written informed consent was obtained from each patient prior to participation.

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