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Research Progress of Bronchoscopy Clinical Anesthesia

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Abstract: ***Bronchoscopy is an invasive examination method, and the anesthesia method of early examination is mainly local anesthesia. However, due to the long operation time of more diagnosis and treatment items, large damage stimulation to patients, and high risk factors, simple local anesthesia can no longer meet the demand. With the popularization of the concept of comfortable medical treatment, the demand for painless bronchoscopy technology is increasing. In the process of examination, the basic situation of patients, economic burden and the shortage of anesthesiologists in the country should be comprehensively considered, and individualized anesthesia plans should be formulated for patients. Select appropriate anesthesia methods such as local anesthesia, sedative anesthesia and general anesthesia to provide clinical reference for reducing patients' anxiety in the process of bronchoscopy operation and improving patient tolerance and comfort.***

Keywords: Bronchioscopy, Anesthesia, Research Progress**.**

1. Introduction

As one of the important examination methods in respiratory medicine, bronchoscopy is of great value and guidance for the diagnosis and treatment of diseases. Bronchoscopy is an invasive and invasive operation. Bronchoscopy operation has a great physical and psychological impact on the patient, mainly because the respiratory tract has a strong rejection reaction to the foreign body that invades the body, which is manifested in the reverse movement of the airway and produces a strong cough. At the same time, the patient's nervous psychology makes the body in a state of stress, which is manifested as blood. Increased pressure, increased heart rate, increased blood sugar [1]. Excessive stress may lead to cardiovascular and cerebrovascular malignant events. Early examination mainly takes local surface anesthesia. Patients are conscious during the examination, and they will refuse to accept the examination due to fear, anxiety and mental tension, or interrupt the examination due to strong suffocation during the examination [2]. Therefore, when performing bronchoscopy for patients, endoscopic operators and anesthesiologists should strengthen communication with patients. At the same time, according to the specific situation of different patients, they should adopt reasonable, appropriate and individualized anesthesia methods, which is of great significance for improving the patient experience and promoting comfortable medical treatment [3].

2. Bronchoscopy

Bronchoscopy has gone through the development stages of traditional hard tracheoscope, fiber bronchoscope, modern electronic bronchoscope/fiber bronchoscope and TV hard bronchoscope, and the technology has gradually matured [4]. In 1897, Gustav Killian, the father of bronchoscopy, used esophagoscopy to remove bone foreign bodies from the esophagus for a patient, pioneering hard endoscopic treatment. By the mid-20th century, hard bronchoscopy had become a major diagnosis and treatment technology in thoracic surgery, but hard bronchoscopy had great irritation to patients and high anesthesia requirements, which limited its further development. In 1967, under the leadership of Japanese scholar Shigeto Ikeda, the world's first fiber bronchoscope came out. As a landmark event in the history of bronchoscopy, it is considered to be the second revolution in the history of bronchoscopy [5]. After Chinese scholars went abroad to study bronchoscopy technology in 1940, they introduced the technology into China, achieving a breakthrough from exploration to maturity and close to the world's advanced level [6]. With the development of medicine, the clinical operation scope of bronchoscopy is becoming more and more extensive, and it has expanded from the original simple bronchoscopy to the diagnosis and treatment items related to bronchoscopy. Diagnosis and treatment items related to bronchoscopy include bronchoscopy alveolar lavage, bronchoscopy biopsy, bronchoscopy pulmonary biopsy, ultrasound-guided bronchoscopy needle suction biopsy, tracheal foreign body clamping, transscopy-guided transscabula biopsy under bronchoscopy ultrasound, peripheral lesion ultrasound small probe-guided by bronchoscopy pulmonary biopsy, diagnosis and treatment techniques of benign and malignant stenosis under bronchoscopy, such as intracheal stent implantation, rigid bronchoscopy, argon plasma coagulation, electrotherapy, cryotherapy, tracheal/intrabronchial balloon expansion, transbronchoscopy radioactive particle (iodine 125) implantation, etc.

As a clinically invasive operation with high stimulation intensity, bronchoscopy can cause patients to have severe cough, chest tightness, laryngeal spasm, tachycardia and other uncomfortable symptoms. In severe cases, respiratory circulatory failure, cardiac arrest, etc [7]. The incidence of potential complications such as hypoxemia, airway obstruction, laryngeal spasm, bleeding, pneumothorax and air embolism during bronchoscopy and treatment is 0.4%-1% [8]. Therefore, special attention must be paid to the safety of bronchoscopy or treatment. With the development of social technology and the popularization of the concept of comfortable medical treatment, patients have higher and

higher requirements for examination and treatment. In the process of bronchoscopy and treatment, the concept of painless and general anesthesia has been gradually introduced, and the operation mode has also developed from the original transnosal/oral intubation/laryngeal mask/hard mirror anesthesia machine for bronchoscopy treatment. The increasing demand for painless bronchoscopy technology can not only improve the accuracy of diagnosis, but also reduce the incidence of complications [9].

3. Anesthesia Guide for Bronchoscopy and Treatment

In 2001, the British Thoracic Association pointed out in the British Thoracic Association's Guidelines for the Diagnosis of Bendable Bronchoscopy [10] that in the absence of relevant contraindications, bronchoscopy and the routine use of intravenous sedative and analgesic drugs was performed. In 2008, the Chinese Medical Association first proposed the regular use of sedative and analgesic drugs in the Guide for the Application of Diagnostic Curvable Bronchoscopy in Adults [11] for the first time. In 2019, the Chinese Medical Association updated the Guidelines for the Application of Diagnostic Bendable Bronchoscopy for Adults [12, 13], which elaborated on the indications, contraindications, preoperative preparation and postoperative management of sedation/anesthesia. In terms of sedation and anesthesia, the guide points out that intravenous sedative and analgesic drugs should be used more actively without contraindications, and benzodiazepine imidazolam is recommended as the preferred drug for sobry sedation. The combination of imidazolam with opioids, propofol and dexmedetomidine can satisfy patients and surgeons. In terms of local anesthesia, the guidelines recommend that 2% Lidocaine gel be used for nasal anesthesia, 1% Lidocaine spray should be used for pharyngeal anesthesia, and the maximum dose of Lidocaine should not exceed 6-7 mg/kg. It is worth noting that due to the poor effect of airway atomization anesthesia, in order to increase the anesthetic effect, clinicians will increase the amount of lidocaine, resulting in drug leakage and adverse reactions after absorption through the conjunctiva. Therefore, airway anesthesia is not recommended through atomization. China's "Consultation of Experts on Tracheoscopy Diagnosis and Treatment Sedation/Anesthesia (2020 Edition)" [14] points out that according to the patient's consciousness suppression level, bronchoscopy sedation/anaesthesia can be divided into four levels, namely, mild sedation, moderate sedation, deep sedation and general anesthesia. Patients need different depths of anesthesia when performing bronchoscopy. Due to individual differences, the same dose of drugs can produce different sedative depths or anesthesia effects for different populations. Therefore, the operation process of bronchoscopy sedation/anaesthesia should be strictly adhered to, the appropriate sedation/anaesthesia plan should be selected, and it is recommended to choose Lidocaine in local anesthesia. Unlike the 2019 Guidelines for the Application of Adult Diagnostic Bend Bronchoscopy [12, 13], the expert consensus suggests that in recent years, inlidocaine aerosol has the characteristics of convenient use, quantitative accuracy, good effect and small adverse reactions, and has become the main method of bronchoscopy and the treatment of local anesthesia. Patients with intolerance to local anesthesia are recommended to use intravenous sedatives to maintain mild and moderate sedative levels. It is recommended to use midazolam combined with fentanyl or sulfentanyl. Deep sedation and intravenous anesthesia on the basis of local anesthesia are suitable for routine bronchoscopy. It is recommended that midazolam, fentanyl, propofol, demetomidine and other drugs are recommended to reduce the adverse reactions caused by different drugs. General anesthesia using a laryngeal mask or tracheal intubation is suitable for complex bronchoscopy operations such as intracheal foreign body removal, tumor removal, removal or placement of stents. It is recommended to use a certain amount of muscle relaxant when performing general anesthesia.

4. Progress in Anesthesia for Bronchoscopy Treatment

4.1 Local Anesthesia

As a traditional anesthesia method of bronchoscopy, local anesthesia plays an irreplaceable role in early bronchoscopy. Good local anesthesia can improve the tolerance of patients in bronchoscopy. Appropriate local anesthesia before surgery can reduce the use of sedation and anesthetics, and improve the safety of the examination process [15]. Therefore, local anesthesia is the basic anesthesia method for bronchoscopy. Drugs commonly used in local anesthesia include procaine, lidocaine, dicaine, etc. At present, guidelines at home and abroad recommend Lidoca because of the preferred drug for local anesthesia [12, 16]. The same concentration of lidocaine works faster, has a strong and long-lasting effect, strong penetration and a larger safety range than prucaine and dicaine. When doing bronchoscopy, bronchoscopy needs to pass through the nasal cavity, oropharynx, glotus, protuberance, etc. Therefore, good local anesthesia for each part is the basis for smooth bronchoscopy. When lidocaine is sprayed in the pharynx and throat, due to the relaxation of the throat muscles, the anesthesia operator needs to be alert to the occurrence of accidental inhalation [8]. The use methods of lidocaine include atomization inhalation method, ring nail puncture method, gargle method and intratrachea drip method [14].

4.2 Sedative Anesthesia

Although local anesthesia can reduce the discomfort of bronchoscopy, it cannot reduce the anxiety of patients. Therefore, an appropriate amount of sedative and analgesic drugs can be used to reduce patients' tension and fear, so that patients can maintain autonomous breathing, improve tolerance and comfort, and receive bronchoscopy diagnosis and treatment quietly and smoothly. Studies have shown that local anesthesia combined with sedative anesthesia can reduce the dose of sedative drugs and increase the effect of their drugs [17]. First of all, sober and sedative patients remain awake throughout the examination process and can respond quickly and correctly to instructions. Benzodiazes are the most used drugs at present, including midazolam and remazolam. Midazolam is the most commonly used sedative. It has the effects of sedation, hypnosis, forgetting and anti-anxiety. It has the least impact on hemodynamics and can be used in tracheoscopy alone [18]. But for the elderly, although low-dose applications also have the possibility of

respiratory inhibition [19]. Common dose of midazolam intravenous injection: the recommended dose for patients under 70 years old is 0.05 mg/kg, and the first dose for patients over 70 years old does not exceed 2 mg [20]. Studies have confirmed that the use of low-dose 0.05 mg/kg midazolam (average 2.6 mg) can achieve mild sober sedation and significantly improve the comfort of patients [21]. Remazolam is a new ultra-short-acting benzodiazepine drug. It has the characteristics of rapid effect and rapid metabolism. It has a light inhibitory effect on respiratory and cardiovascular system. It can be quickly metabolized by carboxylatese into inactive products, and the metabolism does not depend on liver and kidney function [22].

Secondly, the anesthesia management under monitoring is carried out by the anesthesiologist to monitor the patient's vital signs, maintain the respiratory tract, and give sedation and analgesic drugs according to the requirements of bronchoscopy operation. No muscle loosening agents are applied. The patient is in a state of sober or temporary consciousness disappearing, but the patient can quickly restore consciousness by stimulating the patient. There are many kinds of drugs that can be used in this case. 1) Opioids: It has the characteristics of analgesic and relieving cough. At present, the commonly used drugs are fentanyl, sulfentanil, remifentanil and afentanyl. 2) Propofol: The exact mechanism of action is not completely clear, but it is considered to have a variety of regulatory effects. It produces a sedative effect through the positive regulation of γ-aminobutyric acid receptors. It acts on the β3 subunit site, is insoluble in water, and is formulated into a lipid-based emulsion. Propofol is the most widely used intravenous anesthetic drug in the world. It has the characteristics of very fast onset and rapid recovery, but the treatment window is narrow, so it is usually recommended to be used only by anesthesiologists. Propofol may cause hypotension, bradycardia, respiratory depression and potential apnea [23]. 3) Dextometomidine: Dextredetomidine is an alpha adrenaline receptor agonist, which acts on α2 receptors in the brain and spinal cord, reduces the plasma concentration of catecholamine, and plays a calming, analgesic and anti-anxiety effect. In the diagnosis and treatment of bronchoscopy, the use of dexmedetomidine combined with other anesthetic drugs can increase patient tolerance, improve the satisfaction of the operator, and will not have the adverse effects of respiratory depression [24]. 4) Etomide: non-barbiturate intravenous anesthetics have little impact on the circulatory system, slight drop in blood pressure after application, mild respiratory inhibition, do not affect liver and kidney function, do not cause histamine release, but the incidence of injection pain and postoperative nausea and vomiting is high. The main adverse reaction of this drug is to inhibit the adrenal cortical function, so it should be used with caution in people with adrenal cortical insufficiency. 5) Ketamine: Inhibition of excitatory neurotransmitters (including acetylcholine, L-glutamic acid) and interaction with N-methyl-D-aspartic acid receptors to produce anesthetic effects. Ketamine is an intravenous anesthetic with strong analgesic effect. After intravenous injection, it quickly enters a state of sedation and analgesia. Slow administration can protect breathing and airway reflexes, slightly increase heart rate and blood pressure, and expand bronchials. It is a good choice for airway sensitive patients [25]. However, ketamine can cause laryngeal spasm by increasing secretions [26]. Adverse reactions such as nausea, vomiting, hallucinations and anxiety are often used alone. Combined with midazolam and propofol can reduce the incidence of such reactions of ketamine.

4.3 Adverse Reactions of Sedative Anesthesia

The application of sedative anesthesia in bronchoscopy can improve patient tolerance, but it can also cause adverse reactions due to drugs, such as respiratory depression and hypoxia. At present, Ramsay score is often used to evaluate the sedative level at any time throughout the anesthesia process to prevent oversedation and inhibit respiratory and other adverse reactions. Transient hypoxemia is the most common adverse event in bronchoscopy, but most of them are transient and easy to correct through oxygen inhalation [27]. Some studies believe that the most direct cause of hypoxia is respiratory inhibition caused by sedative drugs, but in the absence of sedation and analgesic applications, the part of the microscope occupies and stimulates the airway to cause breath-storeting, choking cough and various operations during microscopic examination can lead to a decrease in oxygen saturation [28]. Therefore, it is recommended to provide routine oxygen support during bronchoscopy under local anesthesia to prevent hypoxia, whether sedation or not. Oxygen supplementation can be achieved through conventional nasal and pharyngeal catheters or high-frequency ventilation.

4.4 General Anesthesia

The general anesthesia used in the early bronchoscopy was inhalation anesthesia, which is now rarely used. General anesthesia for deep sedation requires tracheal intubation or laryngeal mask to ensure ventilation. Because anesthesiologist shares the airway with bronchoscopy, there are some potential complications during the examination process, including airway obstruction, mechanical trauma, bronchospasm, laryngeal spasm, hemodynamic instability, etc. Therefore, total intravenous anesthesia (TIVA) under laryngeal mask ventilation has become the main anesthesia method for bronchoscopy [8, 29]. The advantage of this technology is that anesthetics can be independent of ventilation [8, 15]. General anesthesia usually provides more favorable conditions for the accurate diagnosis of operating doctors, and has advantages in the comfort, forgetfulness and safety of patients. Under the patient's moderate sedation and good local anesthesia, doctors can only complete some simple examinations and operations, while in the patient's general anesthesia, it is easier for doctors to carry out examination and bronchoscopy treatment. Therefore, patients with serious basic diseases and complex diagnostic and treatment procedures generally choose general anesthesia, and for hospitalized patients suspected of contracting COVID-19, they are usually more inclined to general anesthesia [21, 30]. Compared with local combined sedation and analgesic anesthesia, patients have no memory during surgery, blood pressure and blood oxygen saturation are relatively stable, and the sedative and analgesic effects are better [31].

5. Brief Summary

Bronchoscopy diagnosis and treatment visually complete the

evaluation, diagnosis and treatment of respiratory diseases, making the diagnosis and treatment more accurate and less traumatic. Bronchoscopy diagnosis and treatment can develop rapidly on the basis of anesthesia. Through anesthesia, patients' compliance can be improved, the whole diagnosis and treatment process can be implemented smoothly, and patients' safety can be guaranteed, and patients' comfort and satisfaction can be improved. This article mainly discusses the anesthesia methods in bronchoscopy diagnosis and treatment, including local anesthesia, sedative anesthesia and general anesthesia. The specific plan should be according to the patient's wishes, the actual condition, and the complexity of bronchoscopy operation, and choose the anesthesia method suitable for the patient's condition and has little impact on the patient's physiology and psychological, so as to achieve the patient's comfort. The best state with satisfactory operator and low risk.

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