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Research Progress on Traditional Chinese Medicine in the Treatment of Postoperative Cough After Lung Cancer Surgery

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Abstract. Postoperative cough following lung cancer surgery is a common and complex clinical symptom. Modern studies indicate its pathogenesis involves multiple factors, including airway mucosal injury, abnormal neural reflexes, and immune-inflammatory responses. Western medical treatments primarily rely on neuromodulators and antitussives but face limitations in efficacy and potential adverse effects. In contrast, Traditional Chinese Medicine (TCM) demonstrates comprehensive therapeutic advantages through compound formulations, acupuncture, acupoint application, and nebulized inhalation. These approaches regulate Qi and blood, resolve phlegm and dispel stasis, enhance pulmonary function, effectively alleviate cough symptoms, and improve patients' quality of life. Current research should prioritize mechanistic investigations of herbal medicine, advance large-sample evidence-based studies, and optimize the scientific standardization of integrated Chinese-Western medical treatment protocols.

Keywords: Cough after lung cancer surgery; Traditional Chinese medicine compound; Acupuncture treatment; Combined treatment of traditional Chinese and Western medicine.

1. Introduction

Lung cancer is the malignant tumor with the highest incidence and mortality rate worldwide. Lobectomy is one of the main treatment methods for it. Postoperative cough, as a common complication, seriously affects the recovery process and quality of life of patients. In a multicenter study, more than 50% of postoperative lung cancer patients had persistent coughing for more than one year, and approximately 25% of the patients still had no relief of symptoms after five years, indicating that postoperative coughing may be long-term and refractory[1]. At present, the main intervention methods include neuromodulators and behavioral therapy, such as psychological intervention, cough suppression training laryngeal care, etc. However, patients generally report that the effects of these treatment methods are limited and it is difficult to cure cough completely. Some patients tried various treatment methods such as Chinese and Western medicines, diet and lifestyle[2]. At present, there are some drugs in Western medicine for treating cough after lung cancer surgery, such as morphine. Morphine can relieve postoperative shortness of breath in patients with lung cancer, but it is often accompanied by adverse reactions such as constipation and drowsiness. Some patients even withdraw from treatment because they cannot tolerate the above side effects. In contrast, acupuncture intervention has a lower incidence of side effects, higher patient compliance, and can effectively relieve anxiety and respiratory discomfort, providing a safer treatment option for postoperative recovery[3]. Traditional Chinese medicine is playing an increasingly important role in the postoperative rehabilitation of lung cancer. Surveys show that traditional Chinese medicine can improve lung function, regulate immune function and alleviate symptoms by applying treatment methods such as traditional Chinese medicine compound prescriptions, acupuncture, moxibustion and percutaneous electrical stimulation of acupoints, adhering to the therapeutic principle of "strengthening the body's resistance and eliminating pathogenic factors". Traditional Chinese medicine compound prescriptions have the characteristics of multiple components and multiple forms, and have shown positive effects in regulating the body's immunity, inhibiting the proliferation and metastasis of tumor cells, etc. This is conducive to the overall rehabilitation of patients after lung cancer surgery[4]. Although traditional Chinese medicine has shown potential in the postoperative rehabilitation of lung cancer, current research still faces problems such as unclear mechanisms,

insufficient clinical evidence, and the lack of standardization of intervention methods, which limit its wide application.

2. Traditional Chinese Medicine's Understanding of Coughing after Lung Cancer Surgery

The theoretical system of traditional Chinese medicine classifies postoperative cough after lung cancer surgery as internal injury cough, and its core pathogenesis can be summarized as deficiency symptomatic excess, with a mixture of deficiency and excess. The statement in Zhang Jiebin's "Complete Works of Jingyue" that a cough caused by injury must arise from the Yin component is in line with this evidence[5]. This deficiency stems from the sudden injury of qi and blood caused by surgical trauma, leading to the dysfunction of the lung, spleen and kidney. When lung qi is impaired, the exterior defense fails to function properly; when the spleen fails to function properly, phlegm and dampness are generated internally; when the kidney fails to receive qi, coughing and wheezing persist. Among them, the deficiency of both qi and Yin is the key to the pathogenesis. This is in line with modern medical understanding such as postoperative fasting and fluid loss[6], the symptoms are characterized by the adhesion of phlegm, blood stasis and heat. The damage to the meridians caused by surgery leads to the formation of blood stasis that has deviated from the meridians. The disturbance of qi movement by anesthesia intubation and mechanical ventilation results in the generation of phlegm turbidity. When these two factors accumulate, they transform into heat toxins, jointly blocking the lung meridians, causing the lung to lose its ability to disperse and descend, and the airways to become tense and acute[7]. At present, the clinical syndrome differentiation of cough after lung cancer surgery in traditional Chinese medicine is mainly divided into three types: The type of deficiency of both qi and Yin accounts for the largest proportion, with clinical manifestations including dry cough with little phlegm, shortness of breath, low voice, red tongue with little saliva, and often accompanied by low postoperative immune function; The type of phlegm and blood stasis obstructing the lung is characterized by thick expectoration, stabbing pain in the chest and hypochondrium, and a dark purple tongue[8].

3. The Treatment of Cough after Lung Cancer Surgery by Traditional Chinese Medicine

3.1 Traditional Chinese Medicine Compound

Traditional Chinese medicine treats can eliminate pathogenic factors and relieve cough, dissolve phlegm, promote blood circulation, clear heat, dispel colds, and address both symptoms and root causes. Patients with deficiency of both qi and Yin can take Baihe Gujin Decoction. Its ingredients include lily, cooked rehmannia, raw Rehmannia, Scrophularia, Fritillaria, Platycodon grandiflorum, Ophiopogon japonicas, Paeonia lactiflora, Angelica sinensis and licorice. It is suitable for symptoms of Yin deficiency and dry cough with blood in sputum. The lily in Baihe Gujin Decoction contains SO2 and crude polysaccharides of lily, which can suppress cough, regulate immunity and inhibit the growth of cancer cells[9-10]. Total Saponins of lily can induce apoptosis of cancer cell A549 cells[11]. In addition, Scrophularia, Platycodon grandiflorum and Angelica sinensis work together through multiple mechanisms such as anti-inflammation, anti-bacterial, regulation of airway secretion, thinning of sticky phlegm and protection of lung tissue to reduce lung injury, inhibit airway inflammation, relieve cough and expectoration, and promote postoperative recovery of the lungs. It can significantly shorten the duration of symptoms, and the therapeutic effect is better than that of the control group ($P<0.05$). Dingchuan Decoction is derived from "Medical Essentials". Mulberry bark and Scutellaria baicalensis are used to clear heat and relieve cough, and licorice is used to harmonize all these herbs, thereby promoting lung function to descend and clearing phlegm and heat[12]. The main symptoms of blood stasis blocking the meridians are recurrent cough, blood in sputum, ecchymosis on the tongue, chest tightness and chest pain[13]. Patients can take Qianjin Weijing Decoction combined with Maimendong Decoction. It can inhibit the proliferation of lung cancer cells,

improve immune function and prolong the survival period by regulating signaling pathways such as JAK/STAT and EGFR/STAT3[14].

Although traditional Chinese medicine compound prescriptions have shown certain clinical advantages in the syndrome differentiation and treatment of cough after lung cancer surgery and can be classified and treated according to different syndrome types such as qi and Yin deficiency, phlegm and blood stasis blocking the lung, and blood stasis blocking the meridians, the application of Chinese patent medicines still faces many challenges[15]. Some drugs have poor taste and are cumbersome to take, which also affects patients' compliance to a certain extent. It is worth noting that for some modified and modified medications[16], there is still a lack of systematic summaries and clear literature evidence, which restricts their standardized promotion. Therefore, in the practice of traditional Chinese medicine intervening in postoperative cough after lung cancer surgery, evidence-based research should be further strengthened, the principles of addition and subtraction should be standardized, and the therapeutic effect and patient acceptance should be improved.

3.2 Acupuncture treatment

Ancient physicians treating coughs mainly emphasized the combination of selecting acupoints along meridians and by specific regions. Commonly used acupoints included Feishu (BL13), Zhongfu (CV17), and Taiyuan (LU9). Among them, "Selecting Feishu and Taiyuan acupoints is a commonly used selection for treating cough and qi reversal"[17], and modern research also shows that the commonly used acupoints are concentrated in Feishu (BL13), Zusanli (ST36), Shenshu (BL23), Dazhui (DU14), etc., mainly involving the Foot-Sun Bladder Meridian, Ren Meridian, and Hand-Taiyin Lung Meridian[18]. The action of the spinal nerve segments, affects the circulation of qi and blood in the lungs, which is in line with the theory that the meridians pass through and are used to treat the affected areas. Literature in the past decade has pointed out that the mechanism of acupuncture in the treatment of respiratory diseases mainly involves "anti-inflammation and inhibition of airway remodeling, and the targets mainly involve the NF-κB signaling pathway"[19].

Under the dialectical approach of traditional Chinese medicine, different acupoint combination methods are given for different symptoms. For patients with deficiency of both qi and yin, acupuncture treatment mainly focuses on Taiyuan (LU9) and Feishu (BL13). First, acupuncture at Taiyuan is used for tonification, followed by warm acupuncture at Feishu to benefit qi and consolidate the root. Combined with the acupuncture of Zhongfu (RN17) along the skin and the application of tremor technique to stimulate the primoral qi, supplemented by Zusanli (ST36) to tonify the spleen and generate body fluids, Pishu (BL20) cupping to strengthen the middle jiao, and Qihai (RN6) moxibustion over ginger to warm and tonify the primoral qi, the characteristic operations include the injection of Astragalus injection at Feishu and Zusanli acupoints and the thunder-fire moxibustion on the Du Meridian[20-22]. For the type of phlegm and blood stasis obstructing the lung, the treatment mainly involves the deep thrusting and purging method of Fenglong (ST40) combined with the thrusting and cupping technique of Geshu (BL17) to remove bleeding[23]. For the type of blood stasis blocking the meridians, the main points to be selected are the Diaphragm Shu (BL17), Xuehai (SP10), and Sanyinjiao (SP6) to promote blood circulation and unblock the meridians. The Zhongfu Shu (RN17) is combined to regulate and smooth the meridians. For those with emotional depression, qi stagnation and blood stasis, the Liver Shu (BL18) and Taichong (LR3) are added to soothe the liver and regulate qi. For those with chest tightness and palpitations, the Neiguan (PC6) is added to unblock the meridians and calm the heart. The characteristic operation adopts the embedding thread of acupoints for continuous stimulation at locations such as Geshu and Xuehai to consolidate the effect of promoting blood circulation and removing blood stasis[24-25], through the comprehensive application of syndrome differentiation and acupoint selection as well as various characteristic acupuncture techniques, the lung function can be effectively regulated.

3.3 Acupoint application

In acupoint application therapy for pulmonary diseases such as cough after lung cancer surgery, Feishu, Zhongfu and Tiantu are commonly used core acupoints, which have clear therapeutic mechanisms. The Feishu point, as the dorsal Shu point of the lung, is often used for application to treat chronic cough. Studies have pointed out: "By applying and stimulating the Feishu point, lung function can be improved, the immune level can be enhanced, and cough symptoms can be relieved"[26]. The Zhongfu acupoint is where the primary qi converges. Applying it to this point can "regulate and smooth the qi movement, broaden the chest and relieve cough". Application treatment can "significantly shorten the improvement time of cough and expectoration symptoms and reduce the incidence of adverse reactions", and its total effective rate of treatment is higher than that of the medication alone group[27].

Studies have shown that moxibustion at the Feishu point can effectively reduce the levels of serum inflammatory factors in patients, such as CRP, IL-6, and TNF-α, indicating that it has the functions of regulating immunity and alleviating inflammatory responses[28]. "Warm stimulation of the Feishu acupoint can generate local thermal effects through the meridian system, thereby enhancing the body's immunity"[29], providing theoretical support for heat transfer methods of application. In addition, moxibustion stimulating the Feishu point can also improve the respiratory function of patients: Clinical data support that the PaO_2 level in the observation group was significantly higher than that in the control group after treatment, and the $PaCO_2$ level was significantly decreased ($P<0.05$), suggesting that the combined stimulation of the Feishu point has a positive effect on improving the respiratory function of patients. The traditional theory holds that "to treat the internal organs, one should treat their Shu points." The Feishu point is the back-shu point of the lung. Applying this point helps to "generate Yang qi, warm and unblock the exterior and interior, dispel wind-cold, and relieve asthma and cough"[30]. The Zhongfu acupoint is known as the "Qi Meeting Point", which regulates the ascending and descending of qi and alleviates chest tightness, cough and wheezing. It is recorded in "Xie Ke" of "Ling Shu" that: "The ancestral qi accumulates in the chest, emerges from the throat, and runs through the heart meridian to carry out breathing." Modern research holds that "the waxing or waning of the ancestral qi also affects the function of the lungs in charge of breathing"[31]. The Zhongfu organ "can regulate the movement of qi throughout the body" and assist the "diffusion, descent, and descending" functions of the lungs, thereby "coordinating the movement of qi throughout the body"[32]. "The application of Zhongfu acupoint medicinal patches has also achieved relatively satisfactory therapeutic effects in the treatment of chronic bronchitis and asthma in children", and its mechanism of action may be "reducing airway inflammation and achieving bronchial patency" [33]. The Tian Tu acupoint is located in the tracheal projection area, which can relieve sore throat reverse coughing, and directly alleviate irritating dry cough. The Tian Tu acupoint "has less muscle tissue beneath it and is close to important organs", and its application stimulation "can rapidly exert the medicinal effect through the superficial subcutaneous tissue"[34]. Therefore, "acupoint application has a positive therapeutic effect on phlegm-heat type cough"[34]. Studies have shown that the application of Rhubarb powder at the Tian Tu point can significantly improve the syndrome score of cough and expectoration and the number of days of symptom relief, and reduce the average length of hospital stay[35]. The verification results of pediatric clinical trials suggest that pinches on the Tian Tu point in the treatment of wind-heat cough in children are significantly superior to the traditional massage or drug groups, suggesting that the application intervention of Tian Tu point has a significant effect on exogenous cough[35].

In the treatment of cough caused by phlegm-dampness accumulation in the lungs, the combination of traditional Chinese medicine and acupoint application, as a non-invasive external therapy, mainly selects the Dazhui and Tiantu acupoints as the main application sites, along with Feishu, Zhongfu and Zusanli, to enhance the effects of resolving phlegm, benefiting the lungs, strengthening the spleen and eliminating dampness. It can effectively relieve symptoms such as coughing, excessive phlegm and chest tightness. Jiang et al.[36] adopted the basic formula of Xiaoqinglong Decoction combined with Sijunzi Decoction in the study. They mainly selected drugs such as Codonopsis pilosula,

Atractylodes macrocephala, Poria cocos, honey-fried licorice, Ephedra, Cinnamon Twig, dry ginger, Asarum, stir-fried Paeonia lactiflora, Schisandra chinensis, and Pinellia ternata, which warm the lung and transform the drink, and strengthen the spleen and benefit qi, and carried out modified treatments according to different clinical manifestations, for example: For those with blood in the cough, add Baiji and Xianhe Cao; for those with palpitations and insomnia, add Longgu and oyster; for those with fullness and distension in the epigastrium and abdomen, add tangerine peel and Zhike; for those with poor appetite, add Guya, malt and Jiao Sanxian. The medicine is made by grinding white mustard seeds, sweet osmanthus, Asarum, angelica dahurica, cloac, cinnamon, Scutellaria baicalensis, etc. into powder and mixing it with fresh ginger juice in a 1:1 ratio to form a medicinal ball. After being placed in a foam ring, it is applied to the acupoints. Each application lasts about 4 to 6 hours. The initial application can be controlled within 2 hours. Three times a week, and continuous application for 14 days constitute one course of treatment [37]. Furthermore, Lu et al. (2021) pointed out that in the "Treatise on Cold Damage Disorders" on the differentiation and treatment of cough through the six meridians, it is mentioned that phlegm and fluid retention are some of the causes of the disease. The failure of the lung to disperse and descend and the failure of the spleen to transform and transport are the key factors for the internal generation of phlegm and dampness. This supports the external treatment idea of regulating the spleen and lung and strengthening the spleen to transform phlegm, further enriching the theoretical basis of phlegm-dampness-type cough. The treatment basis is derived from the "yang-supporting sequence" theory, emphasizing the treatment sequence of the three jiao: "warming and unblocking the middle and upper jiao, warming and tonifying the lower jiao, and benefiting qi and consolidating the essence"[38]. In terms of acupoint selection, the main acupoints include Feishu (for resolving phlegm and relieving cough), Fenglong (a key point for eliminating phlegm), and Zhongwan (for strengthening the spleen and eliminating dampness). The ingredients used include white mustard seed, sweet gum, Asarum, Angelica dahurica, cloacae, cinnamon, and Scutellaria baicalensis. Asarum warms the lungs, dissolves fluid retention, dispels wind and relieves pain. Angelica dahurica has astringent and cough-relieving effects. Cloves and cinnamon warm the middle, dispel cold, resolve phlegm and relieve cough. Scutellaria baicalensis can clear heat, dry dampness, purge fire and detoxify, which is helpful in controlling lung inflammation. Although acupoint application in the treatment of postoperative cough after lung cancer surgery has shown good therapeutic potential at present, the overall development still faces many bottlenecks and challenges.

3.4 Nebulized inhalation of traditional Chinese medicine

Chinese medicine nebulization inhalation uses ultrasonic waves or compressed airflow to atomize the medicinal liquid into fine aerosol particles. After patients inhale through the mouth and nose, the drugs are directly deposited on the respiratory tract and pulmonary mucosa, thereby achieving the therapeutic purpose of high concentration and rapid onset locally[39]. This therapy originated from the traditional Chinese medicine "nasal therapy" and "fumigation" methods. Combined with modern aerosol delivery systems, it can avoid gastrointestinal degradation and liver first-pass effects, significantly enhancing the bioavailability of active ingredients in traditional Chinese medicine. It has the advantages of small doses, quick onset, and few adverse reactions[40].

For patients with postoperative phlegm-heat obstructive lung type, a lung-moistening and phlegm-resolving formula composed of herbs such as Fritillaria thunbergii, Pinellia fortunei, and Platycodon grandiflorum (20 mL, twice a day) can also be selected for nebulization. This prescription has a remarkable therapeutic effect in the prevention and treatment of pneumonia and atelectasis. The traditional Chinese medicines used in it mostly have the characteristics of clearing heat, resolving phlegm and promoting lung qi. Studies have shown that the incidence of postoperative complications in the treatment group is significantly lower than that in the conventional care group ($P<0.05$)[41]. It is commonly seen after radiotherapy and chemotherapy and during the recovery period of chronic lung diseases, presenting as dry cough with little phlegm, dry throat, and low fever in the afternoon. Studies have shown that nebulized inhalation of Shengmai Dihuang Decoction can significantly improve the

cough and wheezing symptoms of asthma patients with deficiency of both lung and kidney. The total effective rate reached 87.93% after 4 weeks, and the wheezing sound disappeared in 22 cases (accounting for 37.9%)[42-43]. Relevant studies suggest that traditional Chinese medicine atomization may improve the airway mucosal microenvironment by regulating inflammatory factors such as IL-6 and TNF-α, thereby moistening the lungs to relieve cough and reducing the viscosity of sputum. Postoperative cough patients with qi deficiency and phlegm obstruction often present with weak coughing, excessive and thin phlegm, shortness of breath and fatigue, and recurrent episodes[44-45].

3.5 Combined treatment of traditional Chinese and Western medicine

Western medicine holds that the pathogenesis of postoperative cough after lung cancer surgery may be related to multiple factors. Intraoperative operational factors such as prolonged operation time, increased blood loss, malignancy of the tumor, and extensive lymph node dissection may all induce or aggravate postoperative cough[46]. Other treatments such as inhaled corticosteroids combined with β_2 agonists, antihistamines (such as mesylate), remifentanil and intravenous lidocaine also showed certain remission effects[47]. During the operation, the operation mode can be optimized, including shortening the anesthesia time, reducing the damage of energy devices to the bronchi, and fat embedding of the tracheal stump, etc., which can effectively reduce the risk of postoperative cough[47]. The use of cannula-free anesthesia techniques and inhalation hormones combined with analgesics is also considered to be able to reduce the irritation to the respiratory tract[48].

In terms of treatment, the integrated plan of traditional Chinese and Western medicine shows more obvious advantages. Most traditional Chinese medicine practitioners use modified Qingqi Huatan Decoction[49], which has the effects of clearing heat, transforming phlegm, promoting lung function and relieving cough (Damm et al., 2023). Modern research shows that this formula can significantly reduce the levels of IL-6, TNF-α, CRP and PCT in the serum of patients and improve pulmonary function indicators (such as FEV1 and FVC)[50]. Some studies have pointed out that its immunomodulatory effect also includes the intervention of Th1/Th2 cell balance and the control of oxidative stress levels[50]. However, long-term use often has unsatisfactory effects and is prone to induce adverse reactions such as immunosuppression, gastrointestinal injury and drug resistance problems. The clinical manifestations mainly include dry cough without phlegm, shortness of breath and fatigue, dry throat, red tongue with little coating[51]. The initial goal of integrated traditional Chinese and Western medicine therapy is to promote tissue repair and regulate immune homeostasis. Western medicine mainly uses mesylate antihistamines to relieve persistent cough accompanied by airway hyperresponsiveness. Traditional Chinese medicine is suitable for the type of lung Yin deficiency (dry cough with little phlegm, dry throat and mouth, red tongue with little coating)[52].

Although the combined treatment of traditional Chinese and Western medicine has shown significant advantages in the management of cough and chronic respiratory diseases after lung cancer surgery, the following matters still need to be noted: Elderly patients with intractable cough after lung cancer surgery are often accompanied by multi-system functional decline, and the use of drugs requires special attention to individualized regulation[53]. For elderly patients with underlying cardiovascular and cerebrovascular diseases, the effects of cough suppressants on the nervous system and heart rate should be closely monitored to avoid aggravating the original condition[54].

4. Discussion and Future Perspectives

The integrated Chinese-Western approach demonstrates superior efficacy in managing post-lung cancer surgery cough compared to monotherapies. TCM approaches (syndrome-specific herbal formulas like Baihe Gujin Decoction combined with acupuncture) enhance immune function and symptom relief through holistic regulation, while Western interventions (inhaled corticosteroids, antitussives) provide rapid symptom control. Future priorities include: 1) Mechanistic studies on herb-drug interactions 2) Biomarker-guided treatment personalization 3) Standardized protocols for synergistic application 4) Multicenter trials validating therapeutic advantages. This dual-system

strategy aims to establish precision rehabilitation frameworks balancing immediate symptom resolution with long-term functional recovery.

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