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Progress in the Prevention of Complications of Interventional Therapy in Patients with Lung Cancer Hemoptysis

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Abstract

Lung cancer is the malignant tumor with the highest incidence and mortality in our country and even in the world. The radical rate of conventional therapy, such as simple radiotherapy, chemotherapy, operation, traditional Chinese medicine treatment is low and the effect is not ideal. Bronchial lung cancer is one of the most common causes of massive hemoptysis. Vascular interventional therapy has become the first choice in clinical treatment of acute massive hemoptysis. Interventional therapy for lung cancer patients, as a safe, efficient, minimally invasive and economical treatment, has been widely used at home and abroad. However, due to inadequate patient assessment, equipment may not be advanced enough, and treatment techniques need to be developed, more or less postoperative complications associated with interventional therapy may occur. This article reviews the research status of interventional therapy and complication prevention in patients with lung cancer hemoptysis as follows.

Keywords: lung cancer, hemoptysis, interventional therapy, bronchial artery embolization, complication

1. Foreword

The incidence of lung cancer is on the rise year by year. About 1.6 million patients are newly diagnosed with lung cancer every year, and the fatality rate ranks first (Analysis of the latest research of National Tumor Registry Center in 2014, 2015) among malignant tumors. It is estimated that by 2025, China will have 1 million new cases of lung cancer and 900,000 deaths from lung cancer every year, making China the world's largest country for lung cancer (Liu JR, Ke Fei, Tan JNI, et al., 2019). About half of lung cancer patients in the middle and late stages have the symptoms of hemoptysis. When the amount of blood coughing is large, the patients are prone to asphyxiation and death, which requires special attention. The current therapeutic effect of lung cancer hemoptysis patients is not ideal, the curative effect of interventional therapy is better, vascular interventional therapy has become the first choice of clinical acute large hemoptysis treatment. However, due to the patient's condition assessment is not in place, equipment technology is not advanced enough and other reasons, patients with lung cancer hemoptysis will be accompanied by complications after interventional treatment, so medical personnel need to prevent as early as possible. The prevention of complications in the interventional treatment of patients with lung cancer hemoptysis is of great significance to the rehabilitation of patients.

2. About Tumor Interventional Therapy

Interventional therapy is an emerging minimally invasive treatment technique that has developed rapidly in recent years and integrates imaging diagnosis and clinical treatment. Interventional therapy has the characteristics of safety, efficiency and minimally invasive technology, and has become an important part (Wang

B, 2019) of the comprehensive treatment technology of malignant tumor diseases in China. Tumor interventional therapy includes two modes — non-vascular interventional therapy and vascular interventional therapy. The former mainly refers to percutaneous intratumor ablation, while the latter mainly refers to embolization therapy and transcatheter intraarterial infusion chemotherapy. Percutaneous lung ablation is an effective treatment option for patients with early-stage non-small cell carcinoma and minimal metastasis, well tolerated by patients with few (Paez Carpio Alfredo et al., 2021) complications. The common interventional therapy techniques for lung cancer mainly include transcatheter vascular embolization, arterial infusion chemotherapy, ablative therapy, drug-loaded microspheres, etc. (Zhai Xiupeng, 2020).

3. Research Status of Hemoptysis in Lung Cancer

Lung cancer is also the most common malignant tumor in China and even in the world, and the case fatality rate ranks first. The hemoptysis of lung cancer is mostly due to the invasion of malignant tumor cells into the blood vessel wall, resulting in bronchial vascular rupture and bleeding. Clinically, nearly 50% of lung cancer patients have symptoms of hemoptysis, and some patients have sudden massive hemoptysis. Studies have shown that the case fatality rate of massive hemoptysis is 50% ~ 100%, and hemostasis should be treated as soon as possible (Chen Yingjie, 2022; Huanghe, Li Bin, Zhou Hua, Yan Xiaobin, Sun Peng, Chu Jianguo & Shi H P, 2016). The body has two separate cycles, systemic and pulmonary. The blood supply to the lungs involves the pulmonary artery and the bronchial artery (BA). The pressure of the bronchial artery is up to 6 times higher than that of the pulmonary artery. Therefore, once the bronchial artery is destroyed by the tumor, it may cause bleeding and is not easy to stop the bleeding. This can cause severe, life-threatening hemoptysis (Lorenz J, Sheth D & Patel J, 2012). Literature reports (Sidhu M, Wieseler K, Burdick TR, et al, 2008; Yoon W, Kim JK, Kim YH, et al, 2002; Huang Kunlin & Liu Yujin, 2019) that about 90% of the blood supply vessels of massive hemoptysis originates from the bronchial artery, and the remaining 10% come from the pulmonary artery and other body arteries, and the pulmonary artery is about 5%. One of the most common fatal complications in the middle and late stage of lung cancer is massive hemoptysis. With the development and research of modern medical imaging technology, it has been clear that the main blood supply source of lung cancer is BA and systemic circulation, and pulmonary artery is not used as the blood supply of lung cancer cells (Wang X Y, Lv S S & Li J Y, 2022). At present, for patients with lung cancer hemoptysis symptoms, physicians mainly use drug treatment, and surgeons are the main way of treatment is surgery, patients often succumb to asphyxia or hemorrhagic shock, resulting in death, the final treatment effect is not ideal (Zhang Jingxian, et al., 2019).

Since the 1970s, the famous French medical scientist Pemy used percutaneous arterial embolization for the first time to effectively treat acute large hemoptysis caused by bronchiectasis, and since then, the operation has been widely used (Shao B Y & Zhou W H, 2019). In recent years, with the rapid development of interventional medicine, this operation has gradually matured, and at present, it has been recognized as an effective and safe method (Feng T G & Li H X, 2021) for the treatment of massive hemoptysis.

4. Progress in the Application of Interventional Therapy in Patients with Lung Cancer Hemoptysis

Vascular interventional therapy has been widely carried out in the world, because of its advanced minimally invasive technology, can directly act on the target blood vessels, the curative effect is unique, is widely used and promoted (Zhang Qiang, Zhao Wenrui & Sun Xiaodong, 2013). Cordovilla et al. (2016) concluded that intravascular embolization is the safest and most effective method for the treatment of massive or repeated hemoptysis. It has (Papaporfyriou A, Domayer J, Meilinger M, et al, 2021; Ozdemir C, Sokucu SN, Berk A, et al, 2019) been reported that bronchoscopic interventional therapy for endovascular tumor elimination can achieve a higher long-term survival of patients. Hori et al. (2022) have also suggested that trans arterial intervention for lung cancer should be considered as a viable treatment option. Bronchoscopic interventional Therapy, especially Photodynamic Therapy (PDT), can achieve radical curative effect on early invasive cancer and low grade malignancy, and may become a treatment method (Ikeda N, Usuda J & Maehara S, 2020) that can replace surgery.

The onset of lung cancer with massive hemoptysis is acute and the amount of blood loss is large, and the traditional conservative treatment is not effective. Domestic scholars believe that minimally invasive interventional therapy has a better effect and is currently an ideal treatment (Qin Q, 2015). Vascular embolization is a kind of embolization technique with low cost, short time, high curative effect and small risk. Bronchial artery embolization can control massive hemoptysis by directly embolizing the responsible bronchial artery, avoid suffocation and hemorrhagic shock, and can effectively, rapidly and safely control massive hemoptysis (Pu Bo, 2020) caused by direct embolization of bleeding arteries. The effect of interventional therapy on hemostasis by embolizing the responsible vessels of hemoptysis has been recognized by the clinic. Bronchial artery embolization (BAE) is currently the preferred method (CHEN Baorui, ZHOU Dan, NIE Li, et al., 2017)[0] for controlling hemoptysis. BAE is a technique of injecting or feeding embolization substances into the bronchial artery or other responsible vessels through a catheter to block abnormal bleeding vessels and thus achieve the

desired therapeutic purpose. Zhang Qi (Zhang Qi, Lu Chengmei & Fang Wenyan, 2016) reported in the article that the immediate hemostasis rate of BAE was 100% after surgery. This is also consistent with the research conclusions of Cordovilla et al., indicating that vascular embolization is indeed a good choice for the treatment of patients with lung cancer hemoptysis.

Tian Xueqin, et al. (2018) and Li Ronghua, et al. (2015) also mentioned in the study that by injecting chemotherapy drugs into the patient's bronchial artery, it can have an effect on the lesion, with less trauma and faster postoperative recovery, which can improve the survival rate in a certain sense. By increasing the therapeutic target dose and reducing the radiation damage of the surrounding tissue, radioactive I-125 particle implantation can improve the local control rate and response rate of the tumor, and has the advantages of less trauma and faster recovery, which helps to improve the survival rate of patients, and provides a new direction (Li Wei & Ni Caifang, 2018; Cui YL, 2017; Yu X, Li J, Zhong X, et al., 2015) for the anti-tumor treatment of patients with lung cancer hemoptysis.

5. Problems Existing in the Application of Interventional Therapy in the Treatment of Lung Cancer Hemoptysis Patients

5.1 Accompanying Complications

While interventional surgery is widely carried out, it is inevitable that some postoperative complications such as hematoma around the puncture channel, vascular dissection, pulmonary embolism, shock, etc. At present, vascular interventional therapy technology has been implemented in many hospitals at home and abroad. Only a solid grasp of the basic theory of interventional therapy, continuous practice, standardized application of interventional therapy technology, and continuous development of new equipment are required, these factors are essential keys to preventing or reducing the occurrence of complications.

5.2 There Is a Possibility of Recurrence

In addition, patients with lung cancer hemoptysis may also relapse after interventional treatment. The reason of recurrence may be due to a variety of factors (Duan Feng, Wang Maoqiang & Liu Fengyong, 2010), such as blood vessel leakage, embolized blood vessel revascularization, peripheral circulation formation or malignant tumor development. The source of blood supply vessels for hemoptysis is very complicated, the possibility of thrombus leakage during embolization will increase. Through literature review, it is found that after BAE treatment of hemoptysis, the treatment of basic lung diseases should be strengthened to prevent lung infection, so as to further improve the therapeutic effect of arterial embolization. Solid and liquid materials are two commonly used types of BAE embolization. The former mainly includes Polyvinyl alcohol (PVA), Gelatin sponge (GS), microsphere and spring coil. The latter mainly includes iodized oil, N-butyl 2-cyanoacrylate (NBCA) and Onyx liquid embolization system. Various materials have their advantages and disadvantages. It is necessary to select embolization materials and combine embolization with various materials to reduce the recurrence of hemoptysis. If the patient still has hemoptysis after treatment, it is necessary to consider the lesion to supply blood to other arteries, and further embolize other systemic blood vessels to prevent rebleeding. In this regard, Xu Jian et al. (2010) proposed that non-selective angiography should be performed first in order to quickly discover the bleeding artery and take effective embolization measures in order to reduce the possibility of missed detection and effectively control bleeding in a short time. In order to reduce the recurrence rate of embolization and improve the prognosis, the requirements for the use of digital subtraction angiography equipment and super-selective intubation technology should be gradually improved.

6. Research Progress on the Prevention of Complications of Interventional Therapy in Patients with Lung Cancer Hemoptysis

6.1 Bleeding or Hematoma at the Puncture Site

Seldinger technique is generally used in femoral artery puncture. Although this method is relatively safe, it can still cause some damage to blood vessels. However, local bleeding at the femoral artery puncture is often a serious complication. It is often related to the excessive tension of the surgeon after the operation and the inability to press the puncture point effectively in time, which leads to the displacement of the puncture point during the handover process, and the nursing staff does not give the surgeon guidance on the scope, strength and duration of the puncture point, and the patient's premature limb movement and (Xu Chunjing, Zeng Li, Wu Yan & Chen Manshi, 2021) low blood clotting ability. Before surgery, patients should be trained to urinate on the bed, use the bedpan correctly, and guide patients to reduce activities after puncture. After the operation, the patient should be told to apply effective pressure around the puncture point to stop bleeding for more (CAI Xuyang, 2019) than 10 minutes, and then apply salt bag pressure to stop bleeding for 6h after the bandage is pressurized, rest in bed for 24 h after the operation, brake the lower limb of the puncture site to prevent buckling for 12 h, and at the same time, reasonable nursing intervention should be carried out on the patient, pay attention to check the pulse of the dorsal foot artery and observe the skin of the lower limb of the patient. If there is numbness, pain or

cold of the limb, it may be caused by too tight compression bandaging; If the patient is found to be pale or cyanosis, it may be due to arterial embolism, which is a disorder of the endogenous clotting system caused by injury to the endothelial cells of the blood vessels during operation, resulting in arterial thrombosis, which should be reported to the physician immediately and treated with thrombolysis. The nursing staff can effectively prevent the occurrence of adverse events at the puncture site of the blood collector through the above measures.

6.2 Vascular Dissection

During interventional therapy or angiography, due to balloon dilation or improper instrument operation, the vascular interwall layer may split or cause excessive iatrogenic plaque rupture, resulting in the formation of vascular dissection. To avoid dissection, physicians need to continuously improve the accuracy and skill of the procedure. Other medical staff also need to master the relevant knowledge, and properly cooperate with the doctor to deal with the intraoperative situation, so that the operation can be carried out smoothly.

6.3 Spinal Cord Injury (Paraplegia)

The most serious complication of vascular interventional surgery is typically attributed to the high concentration of contrast agents and drugs injected into the blood vessels. This can lead to damage at the anastomosis point between the bronchial artery and the spinal artery, resulting in complications such as spinal artery bleeding, ischemia or obstruction. Ultimately, these complications can lead to paraplegia. Within a few hours after surgery, patients may have transverse spinal cord injury, including limb pain, sensory perception, reduced motor function and other functional disorders, even the urine retention. Therefore, non-ionic contrast agents and solid embolic agents should be used as much as possible during the operation, and chemotherapy drugs should be completely diluted and slowly injected. At the same time, lidocaine induction test should be used to determine whether bronchial artery and spinal artery are co-trunk. If the induction result is positive, more attention should be paid to it (Yang Xizhang, Yang Li, Chen Ziqian & Yang Yongyan, 2008).

6.4 Fever

In most patients, high fever is caused by the injection of chemotherapy drugs or embolic agents into cancer cells, resulting in necrosis of tumor tissue, and the body absorbs a large amount of damaged and necrotic tissue. This fever usually fluctuates around 38 ℃, which is a common symptom in the recovery period after surgery. Studies have shown that early postoperative fever may prolong the healing time (Jin Na, Jiang Ting-Ting & Zou Xiao-Ying, 2023) of surgical incisions, so physical cooling or antipyretic analgesics should be prescribed for patients with high fever. More attention should be paid to the fever generated by patients hours after bronchial interventional surgery. If the fever is transient, it will resolve itself within one day without special treatment (Bu Shi-Yi, et al, 2022). If the patient is the fever caused by pathogenic bacteria infection, it is necessary to carry out anti-infection treatment as soon as possible to avoid the delay of the disease and ensure the safety of the patient's life. Biapenem is excellent in the prevention and treatment of gram-negative bacteria infection, its sensitivity is significantly higher than imipenem and meropenem, and the drug resistance is low, will not increase adverse reactions. A number of studies have shown that the pharmacokinetics/pharmacodynamics of biapenem in different populations can be accurately determined by Monte Carlo simulation method, so as to provide the best prevention and treatment plan for patients. At present, the best use of biapenem for the prevention and treatment of gram-negative bacterial infection is once every 6 hours, each dose of 300mg (Huang Tao & Liu Debin, 2021). Patients with fever should also do a good job of basic care, ask the patient to prepare more clothes, and oral care, after sweating, should change clean clothes as soon as possible to ensure that the skin is clean and dry, to prevent cold infection.

6.5 Pain

Pain is a common manifestation of post-embolization syndrome, usually appearing 1 to 3 days after surgery, primarily edema and swelling pain at the embolization site. When the patient has pain, in order to relieve the symptoms, the patient should be advised to rest in bed, and observe the location, nature, occurrence and development of the pain, using some pain relief methods, such as music, relaxation, psychological suggestion and so on. If the pain is very intense, analgesic and sedative drugs (Wen Yalan, 2010) should be used under the guidance of a physician. Graded analgesia is more effective than conventional drugs such as aspirin, ibuprofen, tramadol. It can relieve the symptoms of physical pain in patients with lung cancer interventional therapy, reduce discomfort, improve the quality of life of patients, and promote patient recovery (Zhao Wenjun, 2019).

6.6 Contrast Agent Nephropathy

The harm of contrast agents to the kidneys is obvious, and too high a concentration of the drug may lead to impaired kidney function, which should be excreted as soon as possible to reduce the damage of contrast agents to the kidneys (Zhang XJ, Wang Huixia & Liu Xiangyu, 2021). To this end, medical personnel need to advise patients to drink plenty of water and strictly follow the doctor's instructions for intravenous fluids to dilute urine and speed up the excretion of drugs from the kidneys. The urine volume of the patient needs to be observed more,

and diuretics should be applied as prescribed by the doctor if necessary. The changes in urine volume, color and nature of the patient should be closely observed and accurately recorded. For patients who often undergo angiographic examination and treatment, astragaloside, (Li Ji, Wang Tian, Fu Qiang, Hu Xiaoyang & Yin Yue, 2022) Junxue (Yu Y, Zheng Y H & Tian H H, 2023) and other drugs can be used appropriately, which has a certain effect on protecting glomerular podocytes, renal tubular epithelial cells, renal tissue and renal vascular endothelial tissue.

6.7 Cardiac Arrhythmia

Due to repeated stimulation of the blood vessels by the catheter during the operation, arrhythmia may occur (Meng Yun-Li, Guo Lin-Lin & Chen Yue, 2018). Therefore, in the operation or after the operation should pay close attention to the patient's signs, strengthen the monitoring of ECG, once found arrhythmia, we should immediately report to the doctor and assist in managing, adjust the patient's position, and asked the patient to rest in bed, maintain emotional stability, so as not to further aggravate the arrhythmia.

6.8 Hypotension

Pay close attention to the changes in the patient's blood pressure before and after the operation as well as during the whole operation. If the patient has hypotension (You JW, 2021), manifested as fatigue, weakness, dizziness, headache, palpitation, chest tightness, and cold sweat, it is necessary to assist the patient to take a horizontal position, and give oxygen inhalation and fluid supplementation to expand blood volume according to the doctor's advice.

6.9 Complications After Chemoembolization

Many chemotherapy drugs not only kill tumor tissues, but also have serious irritation and cytotoxicity to normal tissues. A variety of adverse reactions after chemotherapy have caused great pain to patients, such as gastrointestinal reactions, bronchial ulcers, esophageal ulcers, neurotoxicity, liver and kidney function damage (Yang NN, Xiong F, He Q & Guan YS, 2018; Gießen-Jung C & von Baumgarten L, 2018). Nurses can adopt a brand new intervention nursing model, that is, comfort nursing model (Wang YC & Ma H L, 2020), mainly including psychological comfort, environmental comfort, medication process comfort, chemotherapy side effects comfort, life nursing and family social support guidance 5 aspects. Nurses should strengthen observation, understand the psychological state of patients in advance through questionnaires and verbal communication, maintain a gentle and friendly attitude, and do a good job in psychological counseling patients; The nurse should arrange the ward according to the patient's condition and personal demands in advance, take charge of ventilation and hygiene work, and keep the ward quiet and clean; In the process of medication, nurses should inform patients of adverse drug reactions in advance, adjust the drip rate and body position, explain the precautions and self-observation points of patients, and timely report to medical staff in special cases; Nurses should do a good job of health education: explain the patient chemotherapy do not eat too full, greasy food, do not immediately bed after eating; When there is a feeling of nausea, take a deep breath, sit or side lying position, family members can chat with them, listen to music properly, in order to relax and divert attention; If vomiting occurs, gargle should be timely, intravenous water and electrolyte and nutrition supplement; Encourage patients to eat more calories, protein, vitamin content is high, easy to digest light food, eat more fruits and vegetables, a small number of meals, to love to eat and eat it is appropriate to enhance the body's resistance to promote rehabilitation, while doing regular review. The nurse should also explain the precautions of the family, guide the family to encourage care for the patient, play the family and social functions, make the patient feel the sunshine and be loved, maintain a positive attitude to cooperate with the treatment, and strive to return to normal life as soon as possible.

7. Summaries

Massive hemoptysis in the advanced stage of lung cancer is a serious complication with a high mortality rate. Relevant scholars have pointed out that due to the deficiencies of small sample size, lack of control group, inclusion of heterogeneous groups, or simultaneous use of several different therapeutic measures in the current research on massive hemoptysis of lung cancer, there is a lack of unified diagnosis and treatment norms. The current studies generally believe that interventional therapy has many advantages in the treatment of lung cancer hemoptysis, such as small wound, few adverse reactions, obvious curative effect, repeatability, etc. In short, interventional therapy is feasible both theoretically and practically for the clinical treatment of tumor patients. But only pay attention to the research and development of interventional therapy, its function is limited after all, the long-term effect is not ideal. Experts believe that it is helpful to the diagnosis of massive hemoptysis by refining the history collection, updating the medical equipment and improving the quality of examination. The selection of more practical embolization materials, the improvement of interventional therapy techniques, and the combined application of a variety of interventional therapy programs are more conducive to the treatment of lung cancer hemoptysis patients. In order to ensure that patients undergoing interventional therapy for lung

cancer can obtain the best medical care and improve their quality of life, we, as nursing staff, should fully understand the possible complications in the treatment and the toxic and side effects of chemotherapy drugs, and do a good job of intraoperative and postoperative observation, and take predictive nursing measures to reduce or prevent the occurrence of various complications and adverse reactions. Prolong their survival time. In short, interventional therapy has a broad prospect. In the future, further research and development of more practical interventional materials and equipment, and the development of a higher value theoretical system are the focus of interventional therapy for malignant tumors and the reduction of complications.

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