ADVANCES AND CHALLENGES IN THE TREATMENT OF LUNG CANCER

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Abstract

One of the most common types of malignant tumors is lung cancer. NSCLC is the most common type of lung cancer and is distinguished by a high rate of morbidity and mortality. The current treatment arsenal includes radiotherapy, chemotherapy, targeted therapy, and surgical resection. With a low 5-year survival rate, the outlook is still dreadfully bad in spite of these possibilities. Thus, it is imperative to work toward a paradigm change in therapeutic approaches. Modern methods for treating lung cancer have been made possible by the development of advanced biotechnologies and interdisciplinary integration in recent years. For lung cancer, this article examines the most recent advancements in immunotherapy, photothermal treatment, molecular targeted treatment, and nanodrug delivery.

Keywords: Lung cancer**,** nano drug delivery system**,** molecular targeted treatment system**,** photothermal treatment strategy**,** immunotherapy.

The introduction

Lung cancer has a high rate of morbidity and mortality, making it one of the most prevalent diseases worldwide [1]. Lung cancer is mainly classified as either small cell lung cancer (SCLC) or non-small cell lung cancer (NSCLC) based on the histology of cancer cells. Between 85 and 90 percent of all forms of lung cancer are NSCLC, making it the most prevalent subtype. Large-cell lung cancer, lung squamous carcinoma, and lung adenocarcinoma (LUAD) are among the several histological subtypes that make up non-small cell lung cancer (NSCLC) [2]. For stage I or II NSCLC, adjuvant therapy is used in conjunction with surgical tumor excision. By contrast, chemotherapy or radiation therapy are used when the disease reaches stage III or IV [3], [4]. Nevertheless, the effectiveness of conventional chemotherapeutic medications in treating cancer is restricted by their common drawbacks, which include low absorption, non-specific targeting, and the emergence of drug resistance [5].

Owing to its unique characteristics, the nanodrug delivery system encapsulates therapeutic agents to stop them from degrading. This enhances anticancer efficacy by precisely delivering anticancer medications to tumor sites and minimizing non-specific damage to the target tissue [6, 7, 8, 9]. With the following advantages,

drug delivery by nanocarriers is a revolutionary approach to treating lung cancer. These consist of improved drug bioavailability in the body, improved safety via site-specific anticancer drug delivery, and the ability to release pharmaceuticals over time with regulated release during targeted drug delivery, all of which improve lung therapeutic effects.

As a promising treatment method to investigate in the field of lung cancer therapy, the nanomedicine delivery system offers an alternative to the traditional chemotherapy treatment with several adverse effects [10].

Molecular targeted therapy has emerged as a key NSCLC treatment approach [1,2]. Many receptor tyrosine kinases, including anaplastic lymphoma kinase (ALK), hepatocyte growth factor receptor (c-Met), and epidermal growth factor receptor (EGFR), are essential targets for molecular targeted therapy because they are implicated in cell development and survival [4], [5]. Tyrosine kinase inhibitors, such as gefitinib and erlotinib, have been designed to target EGFR mutations, which are the medicinal target. Additionally, studies on inhibitors that target different targets are also ongoing [8].

Even though there are numerous therapies for lung cancer, there are still many obstacles to overcome. As a result, new and efficient lung cancer therapy methods must be created.

Delivery systems for nanomedicine in the treatment of lung cancer

The following properties of nanoparticle structure include regulated drug release, improved stability of anticancer medications, and simplicity of surface modification [1]. Through the use of their special characteristics, nanoparticles transport nucleic acids and anti-cancer medications to tumor tissues, thereby minimizing side effects and enhancing treatment effectiveness (Fig. 1). A thorough analysis of lung cancer treatment using nano-drug delivery systems was given in this section, with an emphasis on those mediated by several kinds of nanoparticles, including liposomes, exosomes, polymer nanoparticles, magnetic nanoparticles, lipid nanoparticles, and polylactic-co-glycolic acid.

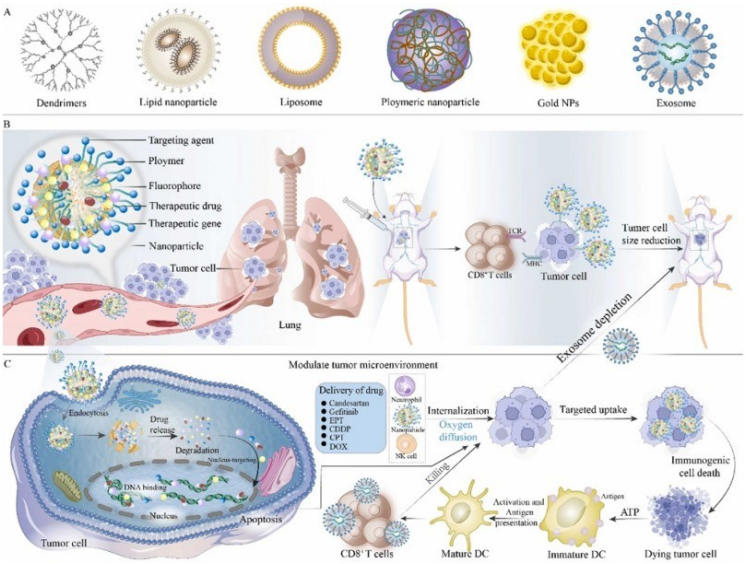

Figure 1: Schematic illustration of medications used to treat lung cancer that are administered by nanotechnology. In order for NPs to more precisely target and eradicate tumor cells, this procedure required altering certain ligands. The advantage of these nanoparticle-based drug delivery systems over conventional therapeutic pharmaceuticals was their ability to deliver medications to tumor tissues more efficiently and specifically, which reduced adverse effects.

Materials and methods Immunization

Immunotherapy provided a novel strategy for fighting lung cancer. In order to create or improve efficient immune responses against tumors, it encompassed a range of techniques, including cellular immunotherapies, cancer vaccines, and immune checkpoint inhibitors (ICIs) (Fig. 4). Immunotherapy has been demonstrated to not only increase patient survival but also enhance their quality of life, and it was notably linked to less adverse effects than chemotherapy [7], [8]. Immunotherapy offered a promising approach to the treatment of lung cancer and was both safe and effective [9],[11].

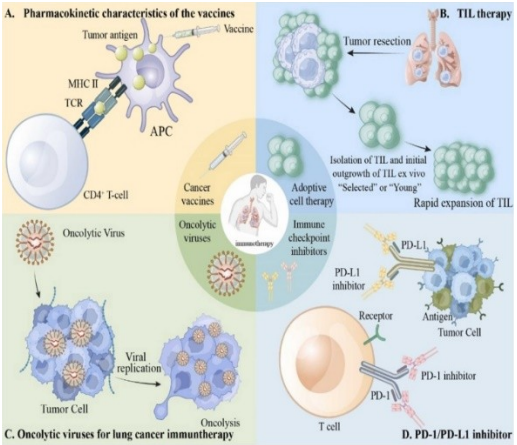

Figure 4. The several immunotherapy approaches for lung cancer were shown in a schematic graphic. Among these tactics were: A: The use of vaccinations tailored to a particular tumor in immunotherapy to prevent lung cancer. B: The use of TIL treatment. C: The use of oncolytic viruses in lung cancer immunotherapy. D: The application of immune checkpoint inhibitors in lung cancer immunotherapy.

Discussion and results

Anti-tumor immune responses may be strengthened by therapeutic cancer vaccines that target particular immune system stimulation [3]. Mutated neoantigens from cancer cells were prime targets for T cell-mediated immunity and showed a great potential to elicit anti-tumor immune responses due to their tumor specificity. These factors were examined for the creation of customized therapeutic cancer vaccines [3], [4]. Animal xenograft models of human lung cancer may show reduced tumor growth when paclitaxel and the oncolytic adenovirus are enclosed in extracellular vesicles [5]. By inducing cytotoxicity linked to immune cell infiltration, a modified oncolytic myxoma virus in conjunction with low-dose cisplatin may considerably increase the survival rate of patients with lung cancer [6].

In conclusion

The prevalence and fatality rate of lung cancer are still frighteningly high worldwide, despite advances in medicine. It is true that early detection and screening can lower the death rate from lung cancer. Over the past few decades, we have gained a better understanding of the molecular biology and clinical characteristics of lung cancer patients, but a really successful treatment is still elusive. This is because conventional lung cancer chemotherapy regimens have numerous drawbacks, which presents a recurring problem for the medical community. Thus, there is a pressing need for lung cancer treatment strategies that are more effective and well-tolerated.

Because of this, the quick development of nanotechnology has made it possible to create medication delivery systems that target nanoparticles, which offers a promising approach to treating lung cancer. Immunotherapy has emerged as a universal, safe, and efficient therapeutic approach. Though primary and secondary drug resistance are still common, ICIs have increased patient survival when compared to conventional chemotherapy medications. Finding biomarkers that can forecast immunotherapy's outcome and prognosis is essential as a remedy.

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