Lung cancer: Updates on screening, biomarkers, and therapeutic innovations in pulmonology.

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Introduction

Lung cancer remains one of the leading causes of cancer-related deaths worldwide, with a high mortality rate largely attributed to late-stage diagnosis and limited treatment options. However, recent advancements in screening methods, the identification of novel biomarkers, and the development of innovative therapies have shown promise in improving outcomes for patients with lung cancer. In this article, we will explore the latest updates in lung cancer screening, biomarkers, and therapeutic innovations in the field of pulmonology [1].

Early detection of lung cancer is crucial for improving patient survival rates. While Low-Dose Computed Tomography (LDCT) has emerged as the primary screening modality for individuals at high risk, recent studies have focused on optimizing screening protocols to enhance efficacy and minimize harms [2].

Several large-scale trials, including the National Lung Screening Trial (NLST) and the NELSON trial, have demonstrated the effectiveness of LDCT in reducing lung cancer mortality among high-risk individuals, such as current or former smokers. These findings have led to the implementation of LDCT screening programs in many countries, offering individuals at risk an opportunity for early detection and intervention [3,4].

Ongoing research aims to refine screening criteria, improve risk stratification models, and evaluate the role of emerging technologies, such as Artificial Intelligence (AI), in the interpretation of LDCT scans. Additionally, efforts to increase awareness and participation in screening programs among eligible populations are underway to maximize the benefits of early detection [5].

Biomarkers play a critical role in the diagnosis, prognosis, and treatment selection for patients with lung cancer. Traditional biomarkers, such as Carcinoembryonic Antigen (CEA) and Cytokeratin 19 Fragment (CYFRA 21-1), have been used to monitor disease progression and response to therapy. However, advances in molecular profiling and genomic analysis have led to the discovery of novel biomarkers with greater specificity and clinical utility [6].

Genetic alterations, such as mutations in the Epidermal Growth Factor Receptor (EGFR), Anaplastic Lymphoma Kinase (ALK), and ROS proto-oncogene 1 (ROS1), have emerged as important biomarkers in Non-Small Cell Lung Cancer (NSCLC). Targeted therapies directed against these molecular targets have demonstrated efficacy in improving outcomes for patients with specific genetic subtypes of lung cancer [7].

In addition to genetic biomarkers, immune biomarkers, such as Programmed Death-Ligand 1 (PD-L1) expression and Tumor Mutational Burden (TMB), are being increasingly utilized to predict response to immunotherapy in patients with advanced NSCLC. These biomarkers help identify patients who are likely to benefit from immune checkpoint inhibitors, such as pembrolizumab and nivolumab, which have transformed the treatment landscape of lung cancer [8].

The treatment of lung cancer has evolved rapidly in recent years, with the development of novel therapeutic modalities aimed at targeting specific molecular pathways and harnessing the immune system to fight cancer. Precision medicine approaches, such as targeted therapy and immunotherapy, have revolutionized the management of both early-stage and advanced lung cancer. Targeted therapies, including Tyrosine Kinase Inhibitors (TKIs) and monoclonal antibodies, have been developed to inhibit aberrant signaling pathways in cancer cells harboring specific genetic alterations. For example, EGFR inhibitors such as gefitinib and osimertinib have shown significant efficacy in patients with EGFR-mutant NSCLC, leading to improved progression-free survival and quality of life [9].

Immunotherapy has emerged as a promising treatment strategy for lung cancer, particularly in the context of advanced disease. Immune checkpoint inhibitors, which block inhibitory pathways that suppress the immune response against cancer cells, have demonstrated durable responses and improved overall survival in patients with NSCLC. Combination therapies, such as immune checkpoint blockade plus chemotherapy or targeted therapy, are being explored to enhance response rates and overcome resistance mechanisms [10].

Conclusion

In conclusion, lung cancer continues to pose a significant public health challenge, but recent advancements in screening, biomarkers, and therapeutic innovations offer hope for improved outcomes and enhanced quality of life for patients.

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Screening programs utilizing LDCT have the potential to detect lung cancer at earlier stages, when curative treatment options are more feasible. Biomarkers play a critical role in guiding treatment decisions and predicting response to targeted therapy and immunotherapy. With ongoing research and collaborative efforts, the field of pulmonology is poised to make further strides in the prevention, diagnosis, and treatment of lung cancer.

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