REVIEW ARTICLE

Lung cancer: Etiology, prevalence, diagnosis and treatment

Diego Falchi[1]

1.   Sassari University Medical School, Department of General Medicine, Sassari, Italy

Abstract

Correspondence

Diego Falchi, Sassari University Medical School, Department of General Medicine, Sassari, Italy

e-mail

diegofalchi@yahoo.it

ORCID ID of the author(s):

DF: 0000-0001-9307-8277

Lung cancer, characterized by uncontrolled growth of abnormal cells in the lungs, is a leading global cause of cancer-related mortality. Its etiology involves a multifaceted interaction of genetic, environmental, and lifestyle factors. Smoking is the most significant risk factor, accounting for about 85% of all lung cancer cases, with other contributors being exposure to environmental toxins like radon and asbestos, air pollution, inherited genetic factors, certain lung diseases, and unhealthy lifestyle habits.

According to the World Health Organization, lung cancer is the most common cancer worldwide, accounting for 2.1 million new cases and 1.8 million deaths in 2020. Its diagnosis is multi-step, beginning with a detailed medical history and physical examination, followed by imaging studies, sputum cytology, biopsy, molecular testing, and finally, staging. Early detection via screening methods like low-dose computed tomography is crucial for improved outcomes.

The treatment for lung cancer is personalized, considering factors like type and stage of the cancer, overall health, and patient's preferences. It could involve surgery, radiation therapy, chemotherapy, targeted therapy, immunotherapy, or palliative care. For instance, surgery, often the first-line treatment for early-stage non-small cell lung cancers, involves removal of either part or all of the affected lung. Other treatment methods target cancer cells, stimulate the immune system, or relieve symptoms.

Due to the complexity of lung cancer, a multidisciplinary approach involving oncologists, radiologists, pathologists, surgeons, and pulmonologists often provides the best outcomes. This team collaboratively devises a comprehensive, patient-tailored treatment plan. Despite advances in diagnostics and therapeutics, lung cancer's prevalence remains alarmingly high, emphasizing the need for continued research and effective preventive strategies.

Introduction

Lung cancer, a leading cause of cancer-related mortality globally, stands as a formidable challenge in the realm of publc health. Characterized by the uncontrolled growth of abnormal cells in one or both lungs, this malignancy often goes undetected until its advanced stages, making it particularly lethal. The primary types, non-small cell lung cancer and small cell lung cancer, each present with different growth rates and patterns, necessitating distinct treatment approaches. Major risk factors include smoking, exposure to secondhand smoke, and environmental toxins. Recent advances in diagnostics, therapeutics, and preventative measures have offered some hope in the battle against this disease, yet the statistics remain alarming. This article aims to provide a comprehensive overview of lung cancer, from its etiology and symptoms to current treatment options and ongoing research, shedding light on its implications for patients, caregivers, healthcare systems, and society at large (1-3).

Etiology

Lung cancer's etiology, or cause, is multifactorial, involving a complex interplay of genetic, environmental, and lifestyle factors. Understanding these factors is critical to developing effective prevention strategies and risk-reduction measures (4).

Smoking: Undoubtedly, smoking is the most significant risk factor for lung cancer, responsible for approximately 85% of all lung cancer cases. This includes not only active smoking but also exposure to secondhand smoke. Cigarette smoke contains over 7,000 chemicals, many of which are proven carcinogens that can damage the cells lining the lungs, leading over time to genetic mutations and the development of cancer (5).

Environmental Exposures: Environmental factors also play a significant role in the development of lung cancer. Exposure to radon, a naturally occurring radioactive gas that can accumulate in homes and other buildings, is the second leading cause of lung cancer in many countries. Other environmental carcinogens include asbestos, certain forms of silica, and diesel exhaust, which are often encountered in specific occupational settings (4).

Air Pollution: Chronic exposure to air pollution, particularly fine particulate matter and pollutants resulting from the burning of fossil fuels, has been shown to increase the risk of lung cancer (4).

Genetic Factors: A small but notable percentage of lung cancer cases can be attributed to inherited genetic factors. Certain genetic mutations increase susceptibility to the disease, and these can be passed down through generations. People with a family history of lung cancer, especially among immediate relatives, have a higher risk, suggesting a genetic predisposition (4).

Previous Lung Disease: Individuals with a history of certain lung diseases, including chronic obstructive pulmonary disease (COPD) and tuberculosis, have a higher risk of developing lung cancer (3).

Lifestyle Factors: Certain lifestyle factors, such as a diet low in fruits and vegetables, lack of physical activity, and alcohol consumption, can contribute to lung cancer risk. These factors may interact with other risk factors, like smoking, to further increase the risk (5).

Prevalence

Lung cancer is a major global health issue, with its incidence and mortality rates emphasizing its significant burden on society. The epidemiology of lung cancer is influenced by various factors such as smoking prevalence, environmental influences, and population demographics.

According to the World Health Organization (WHO), lung cancer is the most common cancer worldwide, accounting for 2.1 million new cases and 1.8 million deaths in 2020. It represents about 11.6% of all new cancer cases and is responsible for nearly one in five cancer deaths. The highest incidence rates are observed in North America, Europe, and East Asia, reflecting the high prevalence of smoking and industrial exposure in these regions (5,6).

Diagnosis

Diagnosing lung cancer involves a multi-step process designed to identify the presence of the disease, determine its type and stage, and inform the most appropriate treatment plan. Here are the key components of lung cancer diagnosis (7):

Medical History and Physical Examination: A thorough understanding of a patient's medical history, including symptoms, smoking history, occupational exposures, and family history of cancer, is the first step. This is followed by a physical examination where the doctor checks for physical signs of lung cancer (7).

Imaging Studies: Imaging tests provide pictures of the inside of the body and are critical in diagnosing lung cancer. A chest X-ray is often the first test, but it can only show abnormal growth, not determine if it's cancerous. More detailed imaging is obtained via computed tomography (CT) scans, positron emission tomography (PET) scans, or magnetic resonance imaging (MRI) to reveal small lesions and determine if the cancer has spread to other parts of the body (8).

Sputum Cytology: In this test, a sample of sputum (mucus) is analyzed under a microscope to detect cancer cells. It's most useful in patients with centrally located tumors that produce sputum (9).

Biopsy: This is the definitive method for diagnosing lung cancer. A biopsy involves removing a small amount of tissue from the suspected area for examination under a microscope. Several techniques can be used, including bronchoscopy, CT-guided needle biopsy, endobronchial ultrasound-guided biopsy, or even surgical biopsy (9).

Molecular Testing: If lung cancer is confirmed, further testing is often done on the biopsy sample to identify specific genes, proteins, and other factors unique to the tumor. This molecular profiling can help determine whether targeted therapies might be effective treatment options (8).

Staging: Once lung cancer is diagnosed, the extent (stage) of the cancer is determined to guide treatment decisions. This involves further tests to see if the cancer has spread within the lungs or to other parts of the body. Staging varies depending on the type of lung cancer, but generally includes Stage I (early stage, localized cancer) through Stage IV (advanced cancer that has spread to other areas) (7).

Early detection of lung cancer greatly enhances the likelihood of successful treatment. Therefore, screening is recommended for high-risk individuals, such as heavy smokers and those with a significant family history of lung cancer. The primary method of screening is low-dose computed tomography (LDCT), which has been shown to reduce lung cancer mortality by detecting cancers at earlier, more treatable stages (7).

Treatment

The treatment of lung cancer is personalized based on several factors including the type and stage of the cancer, the patient's overall health, and the patient's personal preferences. The primary treatment options include surgery, radiation therapy, chemotherapy, targeted therapy, immunotherapy, and palliative care (9).

Surgery: This is often the first-line treatment for early-stage non-small cell lung cancers (NSCLC) that are localized and have not spread. The type of surgery depends on the size and location of the tumor and may include: Lobectomy: Removal of the lobe of the lung that contains the tumor. This is the most common type of surgery for lung cancer. Segmentectomy or wedge resection: Removal of a part of the lobe where the tumor is located. Pneumonectomy: Removal of the entire lung, done when the tumor is located in the center of the lung (10).

Radiation Therapy: This treatment uses high-energy rays or particles to kill cancer cells. It can be used as the main treatment for patients who can't undergo surgery, before surgery to shrink tumors, after surgery to kill any remaining cells, or for palliation in advanced stages of the disease (11).

Chemotherapy: This involves the use of drugs to kill cancer cells or stop them from dividing. Chemotherapy can be administered systemically (through the bloodstream) or directly into the lungs. It may be used before surgery to shrink tumors, after surgery to kill any remaining cells, or as the main treatment for advanced lung cancer (11).

Targeted Therapy: This newer form of treatment targets specific genes or proteins in cancer cells that help them grow and divide. It's mainly used for advanced lung cancers that have certain gene mutations such as EGFR, ALK, and ROS1 (12).

Immunotherapy: This is a type of treatment that stimulates the body's immune system to fight cancer. It's primarily used for advanced lung cancers and can be very effective for cancers with high levels of PD-L1 expression or for those with specific genetic changes (13-15).

Palliative Care: This is a specialized form of care aimed at providing relief from pain and other symptoms of cancer. It's essential at all stages of the disease and can be given alongside curative treatments (15).

It's crucial to note that due to the complexities and variations in lung cancer, a multidisciplinary approach involving a team of specialists including

oncologists, radiologists, pathologists, surgeons, and pulmonologists often provides the best patient outcomes. This team works together to create a comprehensive treatment plan tailored to each patient's unique situation (16).

Conclusions

Lung cancer, driven by an array of genetic, environmental, and lifestyle factors, continues to be a significant global health concern. The prospects for early detection, treatment, and improved survival rates rest upon ongoing advancements in diagnostics, therapies, and preventative measures, underpinned by a holistic, patient-centric care approach.

Conflict of interest:

The authors report no conflict of interest.

Funding source:

No funding was required.

Ethical approval:

No need for reviews

Acknowledgment:

No

Peer-review:

Externally. Evaluated by independent reviewers working in at least two different institutions appointed by the field editor.

Contributions

Research concept and design: **DF**
Data analysis and interpretation: **DF**
Collection and/or assembly of data: **DF**
Writing the article: **DF**
Critical revision of the article: **DF**
Final approval of the article: **DF**

References

1. Krasna MJ. Lung cancer. Surg Oncol Clin N Am. 2011;20(4):xv-xvi.
2. Bade BC, Dela Cruz CS. Lung Cancer 2020: Epidemiology, Etiology, and Prevention. Clin Chest Med. 2020;41(1):1-24.
3. de Sousa VML, Carvalho L. Heterogeneity in Lung Cancer. Pathobiology. 2018;85(1-2):96-107.
4. Nasim F, Sabath BF, Eapen GA. Lung Cancer. Med Clin North Am. 2019;103(3):463-73.
5. Wu F, Wang L, Zhou C. Lung cancer in China: current and prospect. Curr Opin Oncol. 2021;33(1):40-6.
6. Hoy H, Lynch T, Beck M. Surgical Treatment of Lung Cancer. Crit Care Nurs Clin North Am. 2019;31(3):303-13.
7. Jones GS, Baldwin DR. Recent advances in the management of lung cancer. Clin Med (Lond). 2018;18(Suppl 2):s41-6.
8. Sigel K, Makinson A, Thaler J. Lung cancer in persons with HIV. Curr Opin HIV AIDS. 2017;12(1):31-8.
9. Jonna S, Subramaniam DS. Molecular diagnostics and targeted therapies in non-small cell lung cancer (NSCLC): an update. Discov Med. 2019;27(148):167-70.
10. Mao Y, Yang D, He J, Krasna MJ. Epidemiology of Lung Cancer. Surg Oncol Clin N Am. 2016;25(3):439-45.
11. Collins LG, Haines C, Perkel R, Enck RE. Lung cancer: diagnosis and management. Am Fam Physician. 2007;75(1):56-63.
12. Rodriguez-Canales J, Parra-Cuentas E, Wistuba II. Diagnosis and Molecular Classification of Lung Cancer. Cancer Treat Res. 2016;170:25-46.
13. Brody H. Lung cancer. Nature. 2014;513(7517):S1.
14. Brody H. Lung cancer. Nature. 2020;587(7834):S7.
15. Maghfoor I, Perry MC. Lung cancer. Ann Saudi Med. 2005;25(1):1-12.
16. Pallis AG, Syrigos KN. Lung cancer in never smokers: disease characteristics and risk factors. Crit Rev Oncol Hematol. 2013;88(3):494-503.