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A Review on Lungs Tumor Targeted Drug Dlivery System

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Abstract: *Lung tumor targeted drug delivery systems play a vital role in improving the understanding and management of lung cancer. By studying the signs and symptoms, healthcare professionals can detect the disease at an early stage, while analyzing the causes, types, and stages helps in accurate diagnosis and selection of suitable treatment strategies. Conventional treatments like chemotherapy and radiotherapy often lead to severe side effects and toxic effects on healthy tissues.To overcome these limitations, advanced drug delivery approaches—such as passive targeting, active targeting, and dual targeting—have been developed. These systems enable controlled and site-specific delivery of drugs directly to the tumor cells, improving therapeutic efficiency and reducing systemic toxicity.*

Keywords*:* Cancer, lungs, adenocarcinoma, squamous cell carcinoma, large cell carcinoma

I. INTRODUCTION

The lungs are the organs that help us to breath. They help to Give oxygen to all the cells in the body. Lung cancer occurs When lungs cells become abnormal. The rate of lung cancer in Non smokers, who account for as many as 15% of cases, is Often recognized to a combination of genetic factors, gases, Asbestos, and air pollution, including second hand smoke. Lung cancer cells move through the blood or lymph system to another area or organ in the body. (1)

Depending on the stage of cancer, treatment may involve chemotherapy, radiotherapy or surgery followed by chemotherapy and/or radiotherapy.Cancer now causes millions of deaths every year worldwide, while lung cancer is being responsible for 1 in 5 of these deaths, making it the cancer with the highest mortalit rate.(2)

Lung cancer is one of the most common cancers we have and a large number of people die of this disease every year. The disease is often discovered in a late stage, but also in earlier stages lung cancer patients have worse outcome than patients with other cancers. Histological studies of cancer cells have categorized lung cancer into two types: small cell lung cancer (SCLC) and non-SCLC (NSCLC), with SCLC accounting for approximately 15% and NSCLC accounting for approximately 85% of cases (7) NSCLCis further classified into three types: squamous-cell carcinoma, adenocarcinoma and large-cell carcinoma. Squamous-cell carcinoma comprises 25–30% of all lung cancer cases. It occurs from early versions of squamous cells that are present in the airway epithelial cells of bronchial tubes in the centre of the lungs.

This subtype of NSCLC is mainly caused by smoking cigarettes.The long-term survival rate of lung cancer patients treated by conventional approaches such as surgical resection, radiation, and chemotherapy remains far from satisfactory. Most of the chemotherapeutics drugs act on normal cells, inhibitingtheir growth which makes the patient extremely weak and can even result in death. (3)

II. CAUSES

1) Cigarette Smoking
2) Breath in other people's smoke
3) Air pollution

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4) Have someone in family who had lung cancer(4)

III. SIGN AND SYMPTOMS

Symptoms that suggest lung cancer includes:
1) Coughing up blood (hemoptysis)(5)
2) Dyspnea (shortness of breath)
3) Hemoptysis (coughing with blood)(6)
4) Chest pain(7)
5) Cachexia (weight loss), fatigue and loss of appetite (8)
6) It may cause difficulty in swallowing (dysphasia)(9)
7) Dysphonia (horse voice) (10)
8) Muscle weakness(11)
9) Clubbing of fingernails (uncommon)(12)

IV. TYPES OF LUNGS CANCER

Types of lung cancer Lung cancers, also known as bronchogenic carcinomas, are classified into two types.
I) Small cell lung carcinoma (SCLC)
II) Non-small cell lung carcinoma (NSCLC)

I) Small cell lung cancer (SCLC):
It is one of the most aggressive and rapidly growing lung cancers comprising 20% of all lung cancers.This type of cancer is strongly related to cigarette smoking.(13) SCLCs are acquired from the hormonal cells of the lung and are the most dedifferentiated cancers(14)and generally occur as central SCLC often metastasizes rapidly too many sites and is discovered during late stages. Small cell lung carcinoma (SCLC) These cancers are sometimes called oat cell carcinomas.(15) SCLCs remain one of the deadliest malignancies with a 5-year survival rate of less than 7%(16)

II) Non-small cell lung carcinoma (NSCLC)
NSCLC is categorized into three different categories, namely as
a) Adenocarcinoma
b) squamous cell carcinoma and
c) large cell carcinoma.

a) Adenocarcinoma:- Adenocarcinoma is the most common type of lung cancer and comprises around 40% of all lung cancers. Adenocarcinoma is the most prevalent type of lung cancer in both male and female smokersand non-smokers.(17) Most adenocarcinomas occur in the peripheral or external areas of the lungs.(18)
b) Squamous cell carcinoma:- These are also known as epidermoid carcinomas.(19) Squamous-cell carcinoma comprises 25–30% of all lung cancer cases. It occurs from early versions of squamous cells that are present in the airway epithelial cells of bronchial tubes in the centre of the lungs. This subtype of NSCLC is mainly caused by smoking cigarettes.(20)
c) large cell carcinoma: The tumor cells are large and show no other specific morphological traits.(21) Sometimes they are referred to as undifferentiated carcinomas, and they are the least common type of Non-Small Cell Lung Cancer.(22) Large-cell (undifferentiated) carcinoma generally accounts for 5–10% of lung cancers. The central part of the lungs is significantly affected by large-cell carcinoma, which sometimes extends into nearby lymph nodes, the chest wall and distant organs. Largecell carcinoma tumours are strongly associated with smoking.

V. STAGES OF LUNGS CANCER

The stages of a cancer refer to the degree to which a cancer has spread in the body. Stages entail both assessment of a tumor's size as well as the presence or absence of metastases in the lymph nodes or in other organs and also important

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for determining how a particular cancer should be treated. Oncologist may use numerous tests to accurately know the stage of lung cancer like blood tests, X-rays, CT scans, bone scans, and MRI scans.

Stages of non small cell lung carcinoma in order of severity:
Stage I: The tumor is restricted to the lung.(<3cm)
Stages II: The tumor is restricted to the chest.(3 to5 cm)
Stages III: Same as stage II with larger and more invasive tumor.(>5cm)
StageIV: Spread from the chest to other parts of the body.(>7cm)(23)

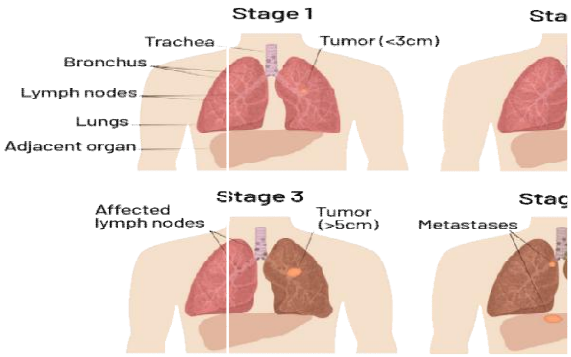

Fig no. 7 stages of lungs tumor(24)

VI. SIDE EFFECTS OF LUNG CANCER

6.1. Disease-Related Symptoms:
• cough,loss of appetite
• chest pain,
• shortness of breath
• Fatigue, weight loss,

6.2. Treatment-Related Side Effects:
I. Chemotherapy:
• Nausea, vomiting,
• hair loss,
• anemia,
• neutropenia,
• kidney or nerve damage

II. Radiotherapy
• lung fibrosis , Fatigue
• Difficulty swalling

III. Targeted Therapy (EGFR, ALK inhibitors):
• Skin rash,
• diarrhea,
• liver toxicity,

IV. Immunotherapy:
Immune-related pneumonitis
• thyroiditis

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• hepatitis
• Joint Pain V.Surgery:
• Infection
Bleeding(25)

VII. TOXICITY OF LUNG CANCER

7.1.Cancer-related toxicity:
• Shortness of breath, cough, chest pain
• Coughing up blood (hemoptysis)
• Fatigue and weight loss
• Spread to other organs → organ-specific symptoms

7.2.Chemotherapy toxicity:
• Low blood counts → infection risk
• Nausea, vomiting
• Hair loss
• Nerve damage (numbness/tingling)
• Kidney/liver toxicity

7.3.Radiation toxicity:
• Lung inflammation (pneumonitis)
• Lung fibrosis → permanent breathlessness
• Esophagitis (painful swallowing)
• Skin redness/peeling

7.4.Immunotherapy & Targeted therapy toxicity:
• Lung inflammation, thyroid problems
• Skin rash, itching
• Fatigue, liver effects(26)

VIII. DIAGNOSIS

Tests to diagnose lung cancer
If your healthcare professional thinks you may have lung cancer, a number of tests can be used to look for cancerous cells and to rule out other conditions.
Tests may include:
• Imaging tests. Imaging tests make pictures of the body. They can show the location and size of the lung cancer. Tests might include X-ray, MRI, CT and positron emission tomography, which also is called a PET scan.
• Sputum cytology. Sputum is the mucus that is coughed up from the lungs. If you are coughing up sputum, it can be looked at under a microscope. The sputum can sometimes show lung cancer cells.
• Biopsy. A biopsy is a procedure to remove a sample of tissue for testing in a lab.Your healthcare team can perform a lung cancer biopsy several ways. One way is bronchoscopy. During bronchoscopy, a healthcare professional passes a lighted tube with a camera down your throat into your lungs to examine the area. Special tools can be passed through the tube to collect a sample of tissue.
Mediastinoscopy also is an option. During mediastinoscopy, an incision is made at the base of your neck. Surgical tools are then inserted behind your breastbone to take tissue samples from lymph nodes.
Another option is a needle biopsy. In a needle biopsy, your healthcare professional uses X-ray or CT images to guide a needle through the skin on your chest. The needle goes into the lung tissue to collect cells that could be cancerous.

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A biopsy sample also may be taken from lymph nodes or other areas where cancer has spread. (27)

IX. TREATMENT OF LUNGS TUMOR

The treatment depends on the type of lung cancer and how far it has spread. Treatments include surgery, chemotherapy, and radiotherapy. (28)

Chemotherapy is used to treat symptoms, prolong survival, and improve the life quality in lung cancer patients who are unable to undergo surgery.(29)

Lung cancer treatment involves surgical chemotherapy, removal of the cancer and radiation therapy, as well as combinations of these treatments.(30)

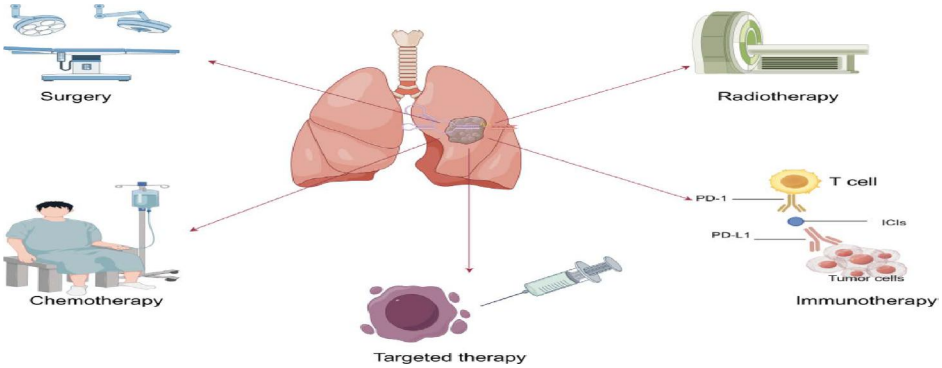

Figure no.8. :-The current primary treatment modalities for lung cancer. PD-1 = programmed cell death receptor 1, PD-L1 = programmed cell death ligand 1.(31)

• Surgery: Surgical removal of the tumor is generally performed for limited-stage (stage I or sometimes stage II) NSCLC and is the treatment of choice for cancer that has not spread beyond the lung. Surgery is still the primary treatment for early stage lung cancer and can improve patient survival.(32)

• Chemotherapy: Chemotherapy is widely used in cancer treatment, however, is rarely effective in this type of cancer due to the low amount of drug available in the lung tissue, even if administered in high doses.Chemotherapy may be given alone, as an adjuvant to surgical therapy, or in combination with radiotherapy. Both NSCLC and SCLC can be treated with chemotherapy.(33)

• Targeted Drug Delivery: These treatment protocols aim to target common molecular changes and may increase the survival rate in non surgical stages.the main aim of the delivery of the drug by the drug targeting concept. The distribution of other tissue seems to be unnecessary, wasteful and a potential cause of toxicity. (34)

• Radiotherapy: The role of radiotherapy in the treatment of lung cancer has become increasingly prominent. However, radiotherapy also faces several challenges, such as increased tumor resistance to radiotherapy and damage to surrounding healthy tissue from ionizing radiation. Therefore, increasing the sensitivity of tumor tissue to radiotherapy can help to enhance the efficacy of radiotherapy.(35)

X. RECENT ADVANCEMENT OF LUNGS TUMOR

Some Recent Drugs for Lung Cancer

1. TelisotuzumabVedotin (Emrelis)

This is an antibody–drug conjugate (ADC) targeting c-Met.In May 2025, the FDA gave accelerated approval for locally advanced or metastatic non-squamous NSCLC with high c-Met expression, for patients who have received prior systemic therapy.The response rate in trials was ~35%, with a median duration of response ~7.2 months.

2. Taletrectinib (Ibtrozi)

An oral, next-generation ROS1 tyrosine kinase inhibitor (TKI).Approved by the FDA in June 2025 for ROS1-positive NSCLC.Because ROS1 fusions drive tumor growth in some NSCLC patients, this gives a targeted option.

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3. Sunvozertinib

A selective EGFR inhibitor for NSCLC with EGFR exon 20 insertion mutations.Received accelerated approval by the FDA in July 2025 for metastatic NSCLC with that specific mutation.

4. Ensartinib (Ensacove)

A ALK inhibitor (TKI) for ALK-positive NSCLC.Approved in December 2024 for ALK-positive locally advanced or metastatic NSCLC in patients who have not previously received an ALK inhibitor.In trials, it showed good activity and also efficacy in brain metastases.

5. Zenocutuzumab

This is the first systemic therapy (a kind of monoclonal antibody) for NSCLC with NRG1 (neuregulin-1) gene fusion.FDA approved it in December 2024 for advanced or metastatic NSCLC with that fusion.

6. Tarlatamab (Imdelltra®)

A bispecific T-cell engager (BiTE) — it brings T cells close to cancer cells to promote killing.Received accelerated FDA approval in May 2024 for small cell lung cancer (SCLC) that has progressed after prior chemotherapy.In a phase 3 trial, it showed durable responses even in heavily pretreated patients.

7. Amivantamab

A dual-targeting monoclonal antibody (EGFR and MET) for EGFR-mutated NSCLC.
There are various approvals and combinations:
Approved in March 2024 (with chemo) for NSCLC with EGFR exon 20 insertion.
Also approved (in some settings) with lazertinib for other EGFR mutations.(36)

XI. CLASSES OF LUNG TUMOR–TARGETED DRUG-DELIVERY SYSTEMS

Class	Main Examples	Key Advantage
Nanoparticles	Lipid, polymeric, inorganic	Tunable properties, high loading
Ligand-targeted systems	Folate-, RGD-, antibody-modified carriers	Receptor-specific uptake
Inhalation-based systems	DPIs, aerosols, nebulized nanosystems	Direct lung targeting
Stimuli-responsive systems	pH, redox, enzyme, magnetic	Triggered drug release
Bio-inspired carriers	Exosomes, membrane-coated NPs	Natural targeting, immune stealth
Polymer–drug conjugates	PEG–drug, HPMA	Longer circulation, controlled release
Local depots	Injectable gels, implants	Sustained localized delivery

XII. CONCLUSION

Lung tumor targeted drug delivery systems play a vital role in improving the understanding and management of lung cancer. By studying the signs and symptoms, healthcare professionals can detect the disease at an early stage, while analyzing the causes, types, and stages helps in accurate diagnosis and selection of suitable treatment strategies. Conventional treatments like chemotherapy and radiotherapy often lead to severe side effects and toxic effects on healthy tissues.

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