EGFR+ Lung Cancer

Important terms

EGFR gene	gives instructions for EGFR protein to grow.
EGFR protein	grows on the surface of cells – it is the switch that turns on and off.
EGF	another protein that switches EGFR protein on when it attaches, and off when it doesn't attach.
Tyrosine kinase	a subtype of protein that includes the EGFR protein.
Tyrosine kinase inhibitor	a type of targeted medicine that stops EGF from attaching to EGFR.

EGFR stands for **epidermal growth factor receptor**. EGFR mutations can occur in some subtypes of Non-Small Cell Lung Cancers including adenocarcinomas and rarely, squamous cell carcinomas. This factsheet will explain what EGFR is, how it relates to lung cancer and how it affects your treatment options.

This factsheet should be read along with our **Understanding a Lung Cancer diagnosis booklet**. **Please click here to download booklet**

Epidermal Growth Factor Receptor Gene (EGFR) Gene

The EGFR gene gives instructions for cells to make the EGFR protein. Sometimes, the EGFR gene can change or be damaged – we call this a mutation. Mutations in the gene can make it too active. This can cause cells to have too much EGFR protein or send too many signals to the cell to grow and make new cells.

EGFR & EGF explained

EGFR is a protein found on the surface of cells. Another protein called EGF (epidermal growth factor) can attach to EGFR. When EGF attaches to EGFR, it sends a message inside the cell telling it to grow and divide (make new cells).

You can think of this like a switch:

ON: When EGF attaches to the EGFR protein, the switch turns on. The cell gets a strong signal to grow and make new cells.

OFF: When they are not attached, the signal is much lower. The cell is less likely to make new cells.

This system helps the body replace old or damaged cells and keeps the number of cells balanced.

When the EGFR gene works properly, it helps keep cells healthy.

However, if there is too much EGFR, the switch can stay on all the time. This causes cells to grow and divide too much. Over time, this can lead to cancer, where too many cells are made and form a tumour.

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Biomarker

You may hear EGFR called a **biomarker**. A biomarker is a marker found on or in a cell or gene. Some biomarkers, like EGFR can be used to diagnose specific cancers. Biomarkers also help doctors work out what medicine can be used to target the cancer cells more directly.

EGFR & lung cancer

Lung cancer can develop when:

- there is too much EGFR on the cell, or
- the EGFR sends too many signals to the cell to grow and make new cells.

Cells begin to grow in an uncontrolled way, and a tumour develops from these cells.

This happens when there is a mutation in the EGFR gene. The mutated gene sends the wrong signals to the EGFR protein, telling it to stay switched on. Mutations can also cause too much activated EGFR to be on the lung cancer cells. Too much EGFR is called overexpression.

When this happens, the lung cancer is called **EGFR positive lung cancer**. It is often written as EGFR+ lung cancer.

There are different types of mutations that can happen within the EGFR gene. Knowing which changes have happened, helps your doctor work out the most effective treatment for you.

What is a mutation in cancer cells?

A mutation is a change that results from damage to DNA inside the cancer cell. These changes can happen for many reasons including prolonged exposure to harmful substances like:

- **radon**
- **asbestos**
- **heavy chemicals**
- **or tobacco smoke**.

Some mutations are inherited – passed down from parent to child. However, the mutations that cause EGFR+ lung cancers are usually not inherited.

Who is at risk of getting EGFR+ Lung cancer?

EGFR+ lung cancer is often diagnosed in younger adults (less than 50 years). Unlike some other lung cancers, we still don't know what causes EGFR+ lung cancer. However, exposure to the harmful substances **listed previously may increase your risk**.

Some studies suggest that females, and people of Asian or Pacific Islander backgrounds have an increased risk of developing EGFR+ lung cancer.

While exposure to tobacco smoke is a risk factor, many people diagnosed with this type of cancer have never smoked or have only smoked a small amount.

How do I know if I have EGFR+ Lung Cancer?

When your doctor suspects you have lung cancer they will order a biopsy. In this procedure, the doctor will take a small sample of the tumour and send it to a laboratory. A scientist will then do several tests on the biopsy to help work out what type of cancer you have. This is called a **tissue biopsy** and is the main biopsy you will have to diagnose lung cancer.

You may also have a blood test or sample of some other fluid in your body to test for cancer cell fragments. This test is a **liquid biopsy**. Liquid biopsies are not as accurate as tissue biopsies but may be used if a tissue biopsy is not possible.

To determine if the lung cancer is EGFR+ the scientist will do extra tests called "Molecular profiling" (also called genomic testing). It is done using tissue from your biopsy to see if there are any mutations in the EGFR gene, or if EGFR is overexpressed on the cancer cells. In addition to EGFR mutations, these tests will look for other mutations that may result in lung cancer. Other names for genetic tests include **Fluorescence In-Situ Hybridisation (FISH)** or **Next Generation Sequencing (NGS)**.

The tests show what part of the gene is mutated. Knowing the type and location of the mutation helps your oncologist plan the best treatment for you.

A treatment target

The discovery of mutated EGFR and its impact on cancer has created a new treatment target. Researchers have found that when the EGFR protein is blocked, EGF cannot attach to it. The EGFR protein then deactivates, is switched off, and can no longer send signals to the cancer cells to grow.

This helps slow or stop the growth of cancerous cells. Medicine used to block EGFR are a type of targeted therapy called Tyrosine Kinase Inhibitors (or TKIs). TKIs are taken long-term as tablets.

Treatments for EGFR+ lung cancer

Treatment may be a combination of targeted therapy, chemotherapy, immunotherapy, radiation therapy, and surgery, or just one of these.

The best treatment for you will depend on several factors including your:

- stage of lung cancer
- other cancer treatments you've had
- other health conditions
- age and overall wellness
- personal preferences.

Early stage

Early-stage lung cancers may only need surgery. Depending on your individual risk factors, you may also be offered chemotherapy before your surgery, or a TKI to take after surgery.

TKIs that target EGFR have become the standard treatment for people with EGFR+ lung cancer. Examples of these medicines include:

Generic name	Brand name
Osimerti**nib**	Tagrisso
Gefiti**nib**	Apotex, Iressa, Cipla
Erloti**nib**	Erlotinib Sandoz, Erlotinib ARX, Tarceva
Afati**nib**	Giotrif

Notice the generic names all end in nib. This is a way to recognise medicine as being a Tyrosine Kinase inhibitor

Locally advanced or advanced stage

EGFR+ lung cancer that has spread outside the lungs to lymph nodes or other organs is usually treated with medicine.

This may include a TKI on its own, or with other medicines such as chemotherapy. Ask your oncologist about the best treatment combination for you.

Refractory EGFR+ lung cancer

Refractory EGFR+ lung cancer means your lung cancer has progressed while having treatment. If your cancer progresses while taking a TKI, you may be offered a different TKI, or chemotherapy with or without a targeted therapy. If the lung cancer is only in one place, you may also be offered radiation treatment. After the radiation treatment, your doctor may recommend you continue taking a TKI.

Ask your lung specialist or oncologist to explain your best treatment options based on your individual cancer and circumstances.

Clinical trials

You may be offered a clinical trial. Clinical trials are research studies that test new treatments to see if they are safe and work well before they become standard treatment. Ask your doctor about clinical trials if you are interested. For more information, please see page 38 of our **Understanding a lung cancer diagnosis booklet**.

Side-effects

Every medicine has the potential to cause unwanted side-effects. Ask your doctor what side-effects to expect and how to manage them at home. For more information on possible side-effects with targeted therapy such as Tyrosine Kinase Inhibitors (TKIs) please visit the **Cancer Council** website.

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Questions to ask your doctor

- What type and stage of lung cancer do I have?
- Does my lung cancer have any mutations or targetable biomarkers? and what are they – can you explain?
- How do these influence my treatment options?
- What side-effects should I expect?
- What are the most serious side-effects of this treatment?
- How can I manage these at home?
- When do I need to seek medical advice, and who do I contact after hours?
- Is the aim of treatment to cure the lung cancer, improve symptoms or keep the disease from growing? Can you explain why?
- Are there any clinical trials suitable for me?
- It there a contact with a lung cancer nurse?

Summary

EGFR is a type of protein that can stimulate cancer cells to grow and multiply when another protein called EGF attaches to it. Cancer occurs when a mutation in the EGFR gene causes the receptor to be stuck in an active state – switched on. This results in too many growth signals, resulting in cancerous cells that form a tumour.

Tyrosine Kinase Inhibitors block the EGFR, deactivating it - switching it on/off which stops or slows the growth signals to cancer cells.

Resources

- **Understanding a lung cancer diagnosis booklet.**
- **Questions to ask your healthcare team - Lung Foundation Australia**
- Facebook groups:
  - Lung Cancer Awareness Support in Australia
  - EGFR+ lung cancer in Australia and New Zealand.

Scan to connect with a Lung Cancer Specialist Nurse or call 1800 654 301.

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