TREATMENT OF CANCER

1. The major objective is to destroy all the cancer cells while causing minimal damage to the normal tissues
2. To treat a particular cancer several different types of treatment may be used alone or in combination.
3. EX: Surgery, Radiotherapy, Chemotherapy, Stem cell therapy, Immunotherapy
4. Surgery is the most frequently used treatment which can cure cancer if done early.

Radiotherapy

1. It uses beam of intense energy to kill cancer cells and it is often combined with surgery.
2. It mostly uses X- rays or Proton radiation.
3. Modern methods of radiation are precise and they don't harm heathy

cells and can be given inside or outside of the body.

4. External beam radiation therapy uses a large machine called a linear accelerator which aims high energy beams to a precise point on the body.
5. Brachytherapy uses a small solid radiation implant in or near the cancer cells inside the body(inside radiation therapy)
6. Radiation therapy damages cells by destroying their genetic material, it may harm some healthy cells.

Chemotherapy(CTX)

1. This includes a wide range of drugs that preferentially but not exclusively, kill the fast growing cancer cells.(But some normal body cells also divide fast (like hair, skin, blood cells), so they also get affected.)
2. The drugs don't only kill cancer cells; they also harm healthy cells that divide fast. Bone marrow cells (make

blood cells) and intestinal lining cells(stem cells) are common victims.

3. Chemotherapy doesn't distinguish perfectly between healthy and cancer cells. It is very harsh for a patient and they usually take it in cycles with rest periods

Side Effect	Cause
Dry flaky skin	Skin cells divide fast
Hair loss	Hair follicle cells divide fast
Nausea and vomiting	Stomach lining irritation
Changes in taste and appetite	N/A
Blood clotting problems	N/A
Fatigue	N/A
Depressed immune system	Bone marrow damage
Possible sterility	Damage to reproductive cells

4. Side effects are mostly reversible but

permanent damages can be done to the kidneys, heart, lungs and reproductive systems.

5. The benefits outweigh the disadvantages and chemotherapy is the most common form of anticancer therapy.
6. Mimics structural component of genetic material or inhibits their synthesis
7. Damages genetic material and blocks its decoding
8. Stop cell division by interfering with chromosomal distribution.(directly attacks the process of cell division)

1. Mimics structural components of genetic material or inhibits their synthesis

- These drugs look like DNA or RNA building blocks (nucleotides).
- When cancer cells try to copy DNA, they use these "fake" blocks.
- Result: DNA can't form properly, stopping cell growth.
- Example: **Antimetabolites** (like 5-FU, methotrexate).

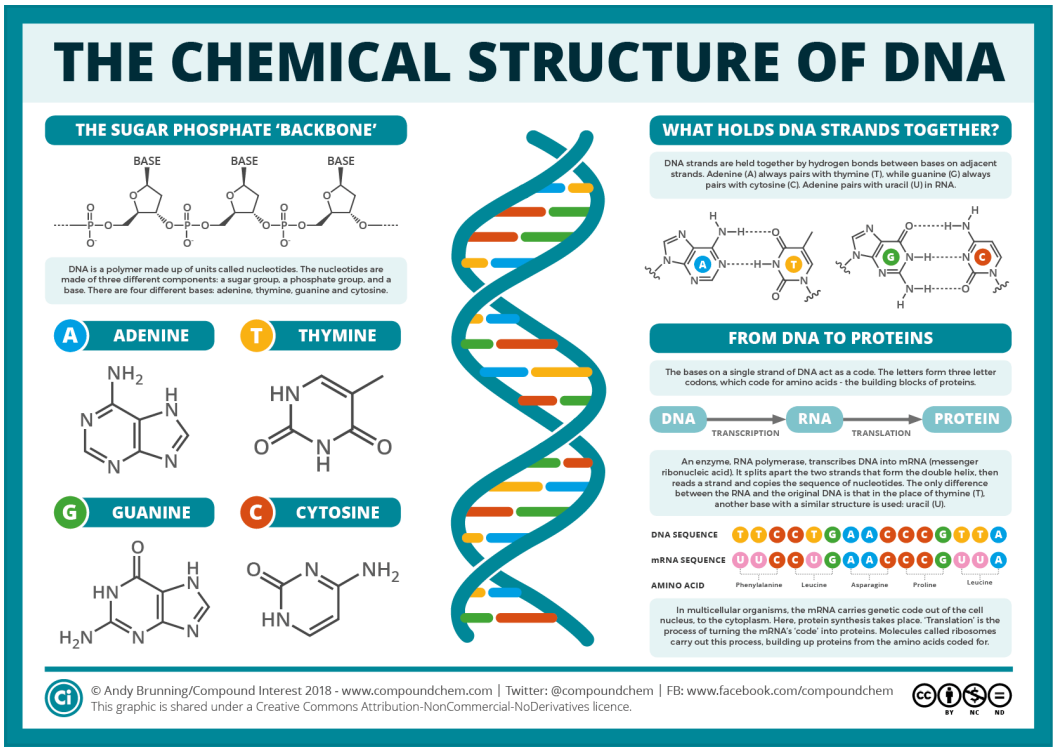
2. Damages genetic material and blocks its decoding

- These drugs directly damage the DNA of cancer cells.
- They may cause breaks, cross-links, or changes in DNA so it can't be read.
- If DNA can't be decoded, the cell can't make proteins and dies.
- Example: **Alkylating agents** (like cyclophosphamide).

3. Stops cell division by interfering with chromosomal distribution

- These drugs don't attack DNA itself but the process of cell division.
- They block the spindle fibers that separate chromosomes during mitosis.
- Without proper division, cancer cells can't multiply.

9.



Chemotherapy	Targeted Therapy
Drugs that affect cells that are dividing rapidly. It is not very specific	Drugs that inhibit a more specific target in cells
Mostly are intravenous, some are oral agents	Many are oral agents

Targeted Cancer Treatment

1. This uses drugs that target the genetic abnormality of tumors.
2. This is currently the focus of anti

cancer drug development. Research is shifting from traditional chemo to targeted therapies

3. Corner stone of personalized cancer treatment or precision medicine(Precision medicine = using a patient's genetic information to design the best treatment)
4. Precision medicine uses info about a persons genes to prevent, diagnose and treat a disease.
5. It produces remarkable clinical response in a specific group of patients with lower toxicity
6. Many targeted cancer therapies have been approved by US FDA
7. They work in different ways:
    - **Prevent cell growth**.
    - **Block tumor blood vessel formation**.
    - **Promote cancer cell death**.
    - **Stimulate immune system**.
    - **Deliver toxic drugs directly to cancer cells**.

Three major types of targeted therapies

Small Molecules	Antibodies	Vaccines
These drugs are small enough to enter in the cells	Lab-made proteins designed to bind to targets on the surface of cancer cells.	These stimulate the patients immune system to recognize and attack cancer cells
They block specific enzyme or protein that the cancer cells requires to grow and survive	They can mark cancer cells for the immune system and deliver toxic substances(like chemo and radiation) directly to the cancer cells	They are not for prevention but for treatment. They train the immune system to identify tumor specific proteins

Small molecules → act inside cells.

Antibodies → act on cell surfaces or deliver drugs.

Vaccines → boost the immune system against cancer.

How to select a patient for targeted therapy

1. Targeted therapy isn't given to every patient It works only if the cancer has a specific target (like gene mutation or abnormal protein)
2. **How doctors decide:**

- **Test the tumor** → Doctors check the patient's cancer cells with lab tests.
- **Find the target** → If the tumor has the abnormality that a drug can block, the patient can take that drug.
- **If no target is found** → The drug won't work, so another treatment is chosen.

Example (CML case):

- In **Chronic Myeloid Leukemia (CML)**, most patients have a broken gene called **BCR-ABL**.
- This gene makes a protein that causes uncontrolled cell growth.
- The drug **Gleevec (Imatinib)** blocks this protein.
- So, patients with the **BCR-ABL gene** are the right ones to get **Gleevec**.

👉 In simple words: **Targeted therapy is like a lock-and-key. If the cancer has the lock (mutation), then the drug (key) can work. If not, the drug won't help.**

Stem Cells

1. They have remarkable potential to develop into many different cell types in the body. (They are undifferentiated and they can turn into any types of specialized cells)
2. In many tissues they serve as internal repair system
3. In some tissues (gut, bone marrow) they continuously divide to replenish/ repair.
4. In some tissues(pancreas, heart, liver) they divide under specific conditions like damage.

Stem Cell Therapy

1. It is the use of stem cells to prevent or treat a disease or condition.

2. It often aims to replace cells damaged or destroyed by disease with healthy functioning ones (transplantation)
3. Cancer stem cells therapy is approved.
4. Types of stem cell therapy:
    1. Adult stem cells transplant using marrow stem cells
    2. Adult stem cell transplants using peripheral stem cells
    3. Stem cell transplants using umbilical cord blood

Marrow

1. Bone Marrow is the soft spongy tissue inside bones which contains stem cells.
2. Marrow makes: RBCs, WBCs(Lymphocyte, monocyte, Eosinophil, Basophil, Neurophil) and Platelets
3. Marrow and stem cell transplant are a life saving treatment option for diseases such as leukemia,

lymphoma and certain genetic disorders.

Bone Marrow Stem Cell Therapy (BMT)

1. For over 30 years BMT has been used to treat patients suffering from leukemia and lymphoma
2. During chemotherapy mostly all the growing cells including blood cells are killed, Bone marrow stem cells form different blood cells
3. BMT can reverse this side effect. Transplanted cells also generate immune response to kill off the cancer cells
4. In short, BMT restores blood cells lost to chemo and helps fight cancer.

How does the patient receive stem cells during the transplant.

1. Patient is first treated with high dose anticancer drugs and / or radiation.

2. Patient then receives stem cells though an intravenous line just like a blood transfusion
3. Stem cell transfusion takes 1-5 hours.

What happens after stem cell transplantation

1. After entering the bloodstream the transplanted cells begin to produce new blood cells called as engraftment.
2. Engraftment occurs 2-4 weeks after transplantations.
3. Complete recovery of the immune function takes much longer (several months when patient receives his own stem cells, 1-2 years when taken from a donor)
4. The patient is constantly monitored to conic that new blood cells are being produced and that cancer has not returned.

Side effects of stem cell transplantation

1. From donors side transplant rejection

2. Transplant causing immune attack on patient's cells

Immunotherapy

1. The immune system helps the body fight infections and other diseases is made up of white blood cells and organs and tissues of the lymph system
2. One reason that the cancer cells thrive is because they can hide from the immune system
3. Immunotherapy is a type of cancer treatment that helps the immune system to fight cancer
4. Certain immunotherapies can mark cancer cells so it is easier for the immune system to find and destroy them.
5. Other immunotherapies boost the patient's immune system to work better against cancer

Side effect of immunotherapy

1. Immunotherapy can cause side effects which may depend on the type if immunotherapy a patient receives and how the body reacts to it
2. The most common side effects are skin reactions at the needle site. The side effects include: Pain, Swelling, Soreness, Redness, Itchiness, Rash.
3. Patient may have flu-like symptoms, swelling, weight gain, heart palpitations, sinus congestion, diarrhea, risk of infection. Fatal allergic reactions may also occur in rare instances

Types of immunotherapy

Types of Immunotherapy

1. **Antibodies** – Lab-made proteins that recognize and attack cancer cells.
2. **Vaccines** – Train the immune system to prevent or fight specific cancers.

3. **Oncolytic viruses** – Modified viruses that infect and kill cancer cells while stimulating immunity.
4. **Genetically engineered immune cell transplants** – Example: CAR-T cells, where a patient's own immune cells are modified to better recognize and destroy cancer.

Why Immunotherapy May Fail

- Some tumors are **"cold" (non-immunogenic)** → they don't trigger a strong immune response.
- Tumors can **hide from the immune system** by disguising themselves or creating a suppressive environment around them.

in short: **Immunotherapy boosts the body's natural defenses, but some cancers avoid detection or don't respond well.**