BIOLOGICAL THERAPY

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Biological Therapy

- Also known as biotherapy or immunotherapy.
- Uses living organisms or substances derived from them.

Definition

- Biological therapy involves the use of natural substances to treat diseases, especially cancer and autoimmune disorders.

History

- Developed in the late 20th century.
- Advances in biotechnology improved its effectiveness.

Types of Biological Therapy

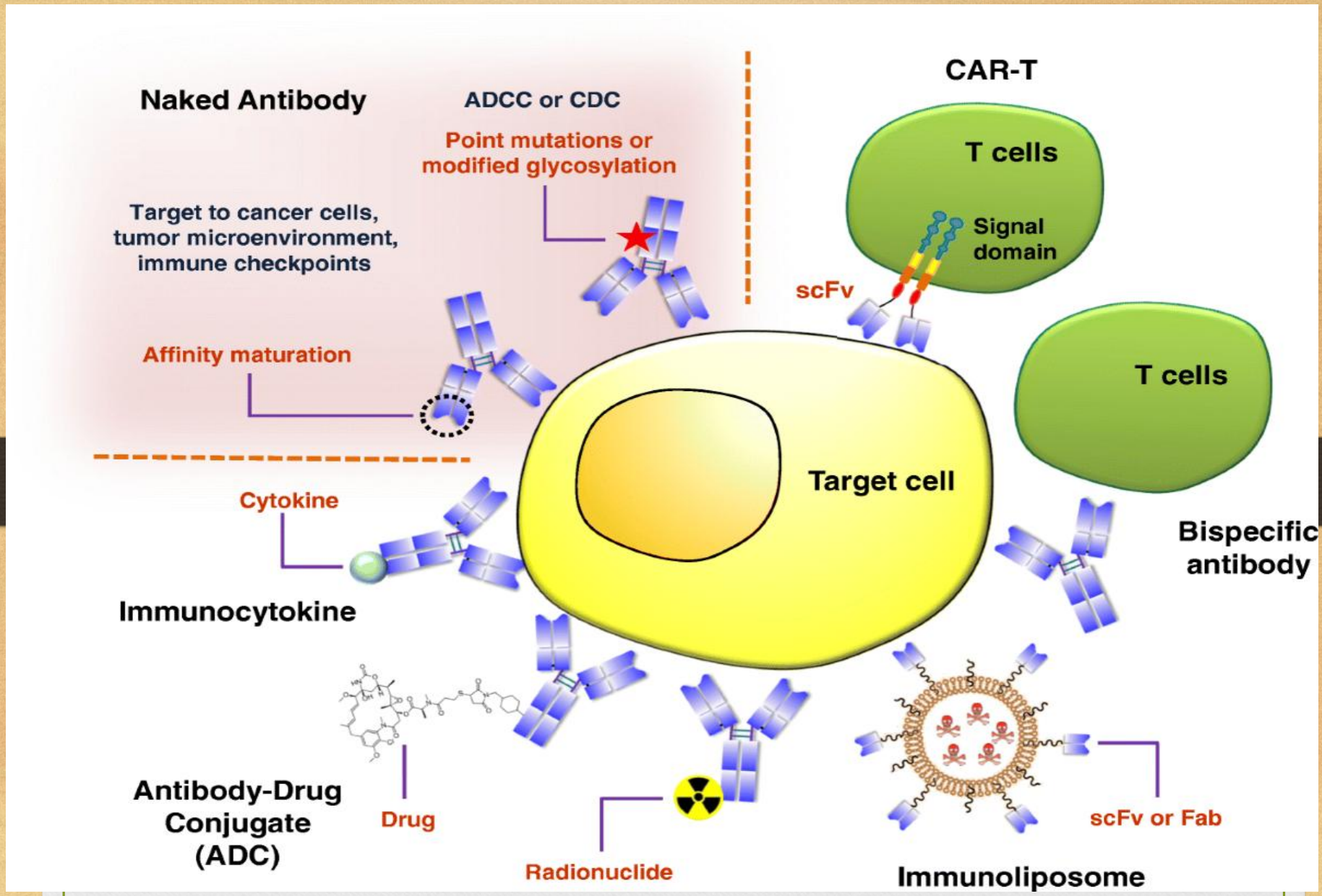
- 1. Monoclonal antibodies
- 2. Cytokines
- 3. Vaccines
- 4. Gene therapy
- 5. Cell-based therapy

Monoclonal Antibodies

- Lab-produced molecules that target specific antigens.
- Used in cancer and autoimmune diseases.
- Monoclonal antibodies bind **specific antigens** on target cells

- They can:
  - Block receptors
  - Mark cells for immune destruction
  - Deliver drugs or toxins to cancer cells

- Scientific note: These therapies are highly **target-specific**, reducing damage to normal cells


Naked Antibody
ADCC or CDC
Point mutations or modified glycosylation
Target to cancer cells, tumor microenvironment, immune checkpoints
Affinity maturation
CAR-T
T cells
Signal domain
scFv
T cells
Target cell
Cytokine
Immunocytokine
Bispecific antibody
Antibody-Drug Conjugate (ADC)
Drug
Radionuclide
Immunoliposome
scFv or Fab

Cytokine Therapy

- Cytokines are small proteins made by immune cells. They help cells communicate and coordinate immune responses
- Proteins like interferons and interleukins.
- Enhance immune response.
- Mainly used in cancer treatment and some infections

Cancer Vaccines

- Stimulate immune system to attack cancer cells.
- Preventive and therapeutic types.

Common types of cytokines used

- **Interferons (IFNs)**
  - Help stop virus replication
  - Slow cancer cell growth

- **Interleukins (ILs)**
  - Stimulate immune cells (like T-cells)
  - Example: IL-2 activates white blood cells

  - How it works

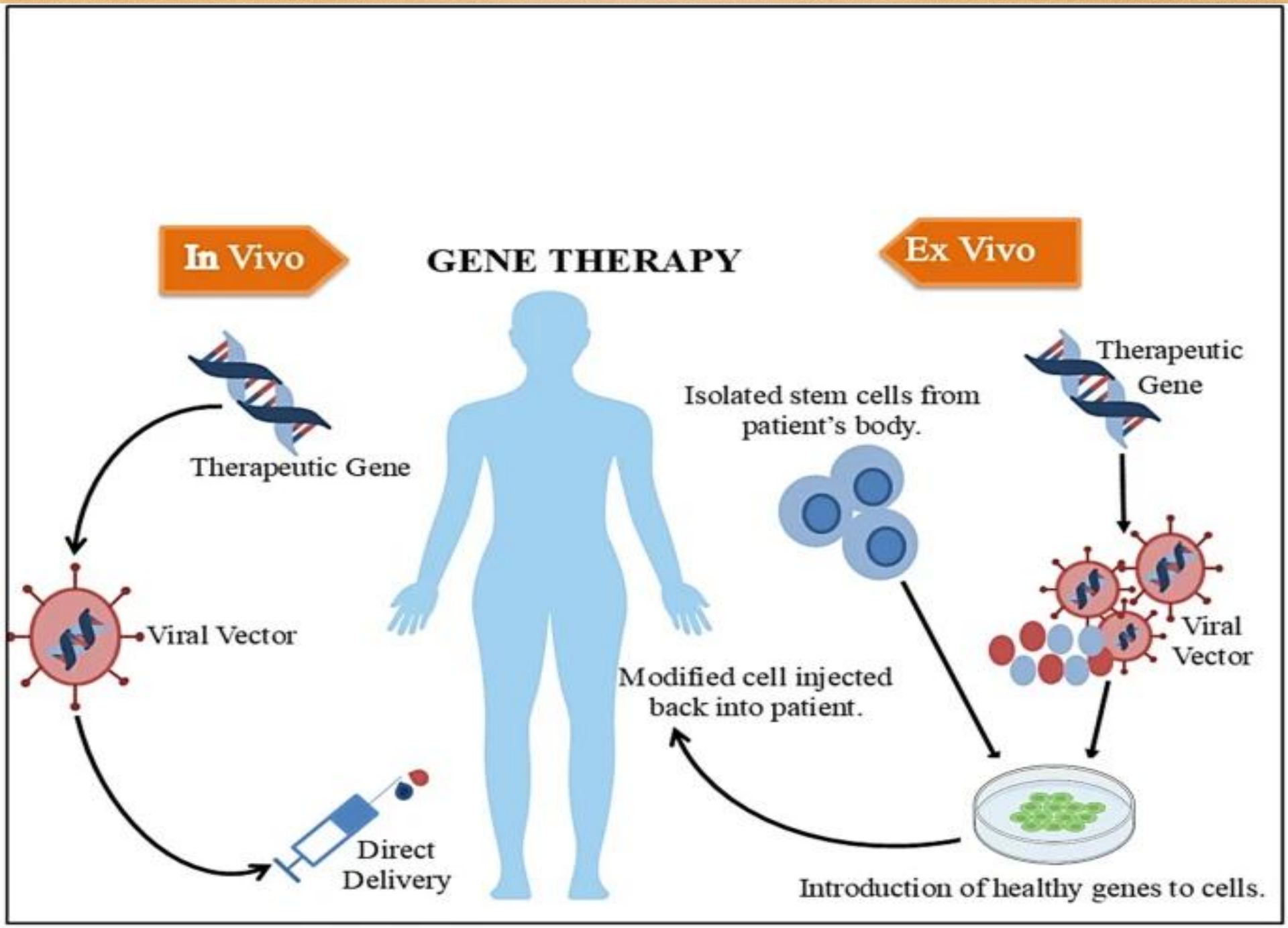
Enhances the body's natural defense
Helps immune cells:Recognize abnormal cells
Attack cancer or infected cells

Gene Therapy

- Gene therapy is a medical technique that treats or prevents disease by modifying a person's genes instead of using drugs or surgery

- Replacing a disease-causing gene with a healthy copy of the gene
- Inactivating a disease-causing gene that is not functioning properly
- Introducing a new or modified gene into the body to help treat a disease

- Replace a faulty gene
- ➤ A damaged gene is replaced with a healthy one.
- Inactivate a harmful gene
- ➤ A gene that causes disease is turned off.
- Add a new gene
- ➤ A new gene helps the body fight disease


In Vivo
GENE THERAPY
Ex Vivo
Therapeutic Gene
Viral Vector
Direct Delivery
Isolated stem cells from patient's body.
Modified cell injected back into patient.
Therapeutic Gene
Viral Vector
Introduction of healthy genes to cells.

Types of Gene Therapy

1. Somatic Gene Therapy

- Targets **body cells (non-reproductive)**
- Effects are **not passed to children**
- Most commonly used in medicine today

2. Germline Gene Therapy

- Targets **sperm or egg cells**
- Changes are **inherited by future generations**
- Still controversial and mostly experimental

Examples of Diseases Treated

- Cystic Fibrosis
- Hemophilia
- Sickle Cell Disease
- Some cancers
- Advantages
- Can treat the root cause of diseaseMay provide long-term or permanent cureReduces need for repeated treatment

Disadvantages /

Risks

Immune reaction to the vector

High cost

Not effective for all diseases yet

Possible unintended genetic changes

Cell-based Therapy

- **Includes stem cell therapy.**
- Stem cell therapy is defined as the use of stem cells, which can develop into various forms of human tissue, to produce transplantable tissues for therapeutic purposes, particularly in repairing damaged or diseased organs.
- Used for regeneration and immune modulation.

Stem Cells

Totipotent cells

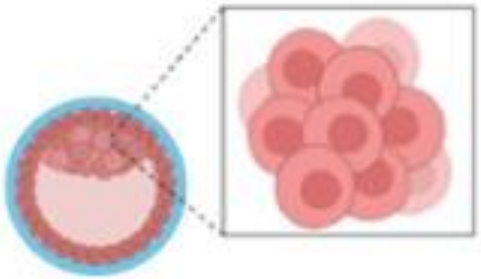
Differentiates into any type of cells.

Eg: Zygote

Pluripotent cells

Differentiates into germ line layers namely, ectoderm, endoderm & mesoderm.

Eg: Embryonic stem cells



Multipotent cells

Divides into all type of cells in a specific lineage.

Eg: Hematopoietic stem cells

Oligopotent cells

Differentiates and self renewal of two or more type of cells within a specific tissue.

Eg: Lymphoid stem cells

B Cell

T Cell

Unipotent cells

Differentiates into only one type of cell.

Eg: Epidermal stem cells producing skin.

Applications

- Cancer treatment
- Autoimmune diseases
- Infectious diseases

Advantages

- Targeted treatment
- Less damage to healthy cells
- Improved outcomes

Disadvantages

- Expensive
- Side effects like inflammation
- Not effective for all patients

Side Effects

- Fatigue
- Fever
- Immune reactions
- Organ toxicity