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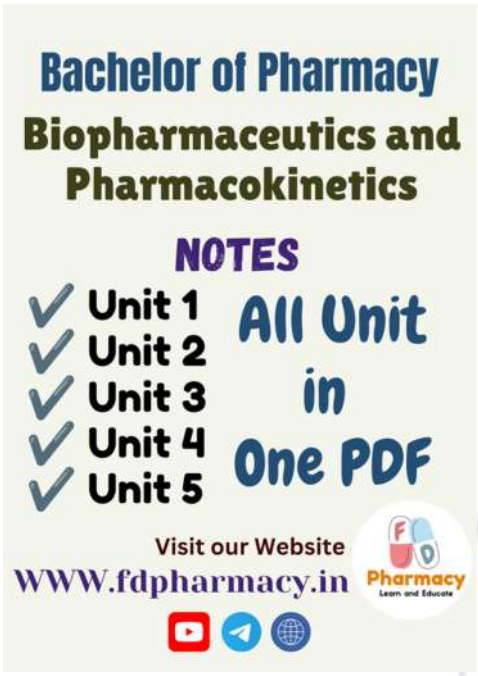
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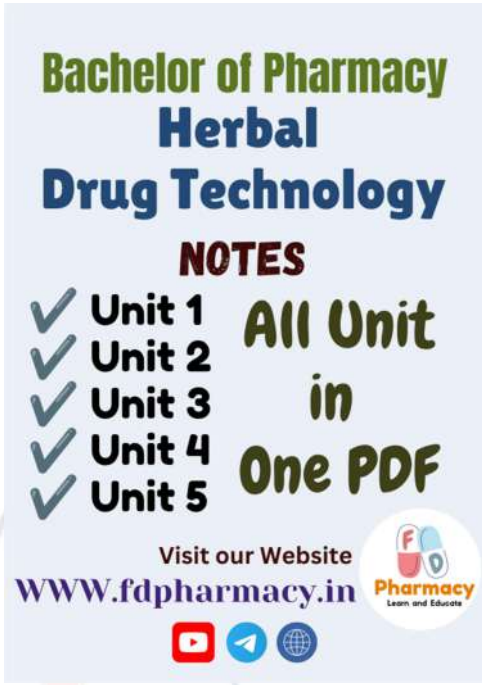
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PHARMACOLOGY - III

UNIT 4

TOPIC :

- **Immunopharmacology**

  a. Immunostimulants

  b. Immunosuppressant

  Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

Immunopharmacology

→ Immunopharmacology is the branch of pharmacology that deals with drugs affecting the immune system by either stimulating (immunostimulants) or suppressing (immunosuppressants) immune responses.
→ It also studies immune mediators such as cytokines, antibodies, interleukins, and interferons and their interaction with drugs.

Importance of Immunopharmacology

- Protects the body from infections and foreign substances.
- Helps treat autoimmune diseases.
- Prevents organ transplant rejection.
- Plays an important role in cancer therapy.
- Used in allergy treatment.
- Helps in vaccine development.
- Maintains the balance between overactive and underactive immune responses.

Components of the Immune System

1. Innate Immunity

- First line of defense.
- Non-specific immunity.
- Includes macrophages, neutrophils, dendritic cells, and natural killer (NK) cells.
- Provides immediate protection.

2. Adaptive Immunity

- Specific immunity.
- Includes T-lymphocytes and B-lymphocytes.
- Produces antibodies.

- Forms immunological memory.

3. Chemical Mediators

- Cytokines
- Interleukins
- Interferons
- Tumor Necrosis Factor (TNF)
- Complement proteins

Role of Immunopharmacology

1. Organ Transplantation

- Prevents rejection of transplanted organs.

2. Autoimmune Diseases

- Suppresses abnormal immune responses.

3. Cancer Therapy

- Stimulates immune cells to destroy tumor cells.

4. Allergy Treatment

- Controls hypersensitivity reactions.

5. Vaccine Development

- Provides long-lasting immunity against infectious diseases.

Classification of Immunopharmacological Drugs

A. Immunostimulants

- Increase immune response.

B. Immunosuppressants

- Decrease immune response.

C. Biological Response Modifiers

- Modify immune function.

Examples:

- Monoclonal antibodies
- Cytokines
- Recombinant proteins

Immunostimulants

→ Immunostimulants are drugs that increase the body's immune response by stimulating immune cells or increasing production of immune mediators.

Mechanism of Action

- Activate T-lymphocytes.
- Stimulate B-lymphocytes.
- Activate macrophages.
- Increase Natural Killer cell activity.
- Increase cytokine production.
- Increase antibody formation.

Classification

1. Specific Immunostimulants

→ Produce immunity against a particular antigen.

Vaccines

Examples

- BCG vaccine, Hepatitis B vaccine, Polio vaccine
- MMR vaccine

Toxoids

Examples

- Tetanus toxoid
- Diphtheria toxoid

Immunoglobulins

Examples

- Rabies immunoglobulin
- Hepatitis B immunoglobulin

2. Non-Specific Immunostimulants

Increase general immune response.

Examples

- Levamisole
- BCG vaccine
- Interleukin-2
- Interferons

1. BCG Vaccine

→ Live attenuated vaccine prepared from *Mycobacterium bovis*.

Mechanism

- Activates macrophages.
- Stimulates T-cells.
- Produces cell-mediated immunity.

Uses

- Tuberculosis prevention.
- Bladder cancer immunotherapy.

Adverse Effects

- Injection site ulcer.
- Fever.
- Malaise.
- Lymph node swelling.

2. Levamisole

→ Synthetic antihelminthic drug possessing immunostimulant activity.

Mechanism

- Stimulates T-cells.
- Activates macrophages.
- Enhances antibody production.

Uses

- Colon cancer.
- Aphthous ulcers.
- Immunodeficiency.

Adverse Effects

- Nausea.
- Vomiting.
- Fever.
- Agranulocytosis.

3. Interleukin-2 (Aldesleukin)

→ Recombinant human IL-2.

Mechanism

- Stimulates cytotoxic T-cells.
- Activates Natural Killer cells.
- Enhances cell-mediated immunity.

Uses

- Renal cell carcinoma.
- Malignant melanoma.

Adverse Effects

- Hypotension.
- Capillary leak syndrome.
- Fever.
- Chills.

4. Interferons

→ Naturally occurring glycoproteins having antiviral and immunomodulatory actions.

Types

IFN-α

- Viral hepatitis.
- Hairy cell leukemia.

IFN-β

- Multiple sclerosis.

IFN-γ

- Chronic granulomatous disease.

Mechanism

- Inhibit viral replication.
- Activate macrophages.
- Increase MHC expression.

Adverse Effects

- Flu-like symptoms.
- Depression.
- Bone marrow suppression.

5. Thymic Hormones

Examples

- Thymosin.
- Thymopentin.

Mechanism

- Promote maturation and differentiation of T-lymphocytes.

Uses

- Immunodeficiency disorders.

Adverse Effects

- Usually mild.

Immunosuppressants

→ Immunosuppressants are drugs that reduce or suppress immune responses to prevent tissue damage caused by excessive immunity.

Mechanism

- Inhibit T-cell activation.
- Reduce cytokine production.
- Inhibit antibody synthesis.
- Prevent lymphocyte proliferation.

Classification

1. Calcineurin Inhibitors

Examples

- Cyclosporine
- Tacrolimus

MOA

- Block calcineurin enzyme → inhibit IL-2 synthesis → prevent T-cell activation.

Uses

- Kidney transplant.
- Liver transplant.
- Heart transplant.

Adverse Effects

- Nephrotoxicity.
- Hypertension.
- Tremors.

2. Antiproliferative Drugs

Examples

- Azathioprine.
- Mycophenolate mofetil.

MOA

Inhibit DNA synthesis in lymphocytes.

Uses

- Organ transplantation.
- Rheumatoid arthritis.
- Lupus.

Adverse Effects

- Bone marrow suppression.
- Infection.

3. Corticosteroids

Examples

- Prednisolone.
- Dexamethasone.

MOA

Suppress cytokine production and inflammatory mediators.

Uses

- Autoimmune diseases.
- Asthma.
- Organ transplantation.

Adverse Effects

- Osteoporosis.
- Diabetes.
- Weight gain.

Protein Drugs

→ Protein drugs are therapeutic proteins produced using recombinant DNA technology to treat diseases by acting specifically on immune targets.

Types

Cytokine inhibitors

Example

- TNF-α inhibitors.

Fusion proteins

Example

- Etanercept.

Recombinant proteins

Examples

- Interferons.
- Interleukins.

Mechanism

- Bind cytokines.
- Block immune receptors.
- Prevent inflammation.

Uses

- Rheumatoid arthritis.
- Psoriasis.
- Crohn's disease.
- Organ transplantation.

Adverse Effects

- Infection.
- Allergy.
- Rare malignancy.

Monoclonal Antibodies

→ Monoclonal antibodies are laboratory-produced antibodies directed against one specific antigen.

Advantages

- Highly specific.
- Less toxicity.
- Targeted action.
- Better therapeutic response.

Examples

Muromonab-CD3

- Target: CD3
- Use: Transplant rejection.

Basiliximab

- Target: IL-2 receptor (CD25)
- Use: Kidney transplantation.

Rituximab

- Target: CD20
- Use:
  - Non-Hodgkin lymphoma.
  - Rheumatoid arthritis.

Infliximab

- Target: TNF-α
- Use:
  - Crohn's disease.
  - Rheumatoid arthritis.

Adverse Effects

- Infusion reactions.
- Fever.
- Chills.
- Opportunistic infections.
- Hypersensitivity.

Target Drugs to Antigen

→ Targeted drugs specifically bind disease-related antigens and deliver therapy directly to diseased cells while sparing normal tissues.

Mechanism

- Recognize target antigen.
- Bind specifically.
- Block receptor function or deliver cytotoxic drug.
- Destroy target cells.

Examples

Alemtuzumab

- Target: CD52
- Uses:
  - Leukemia.
  - Multiple sclerosis.

Omalizumab

- Target: IgE
- Uses:
  - Severe allergic asthma.
  - Chronic urticaria.

Brentuximab Vedotin

- Target: CD30
- Uses:
  - Hodgkin lymphoma.
  - Anaplastic large-cell lymphoma.

Advantages

- High specificity.
- Less damage to healthy tissues.
- Better efficacy.
- Reduced adverse effects.

Adverse Effects

- Immunosuppression.
- Allergy.
- Cytokine Release Syndrome (CRS).

Biosimilars

→ Biosimilars are biological medicines that are **highly similar** to an already approved reference biologic in terms of **quality, safety, and efficacy**, but are not identical due to the complexity of biologic manufacturing.

Characteristics

- Produced using living cells.
- Comparable efficacy and safety to the reference product.
- Lower cost than original biologics.
- Undergo strict regulatory evaluation.

Examples

- Adalimumab biosimilars.
- Infliximab biosimilars.
- Etanercept biosimilars.
- Rituximab biosimilars.

Advantages

- Lower treatment cost.
- Improved patient accessibility.
- Same therapeutic benefits.
- Reduced healthcare expenditure.

Limitations

- Manufacturing complexity.
- Risk of immunogenicity.
- Cold-chain storage required.
- Strict regulatory approval process.