



**Department Of Biotechnology**

# **Immune System**

**By**

**Dr. Sapna Baghel**

# INTRODUCTION

- **Immunity** : Defence capacity of the body to combat diseases — counter infection.

**Immune System:** Molecules, cells, tissues and organs which provide non-specific and specific protection against, Microorganisms, Microbial toxins, Tumor cells.

# **The Immune System**

## **3 Major Functions**

- 1.** Protection from disease causing invaders
- 2.** Removal of dead /damaged tissues & cells
- 3.** Recognition & removal of abnormal cells

# Types Of Immunity

- **Inborn or innate immunity:** It is present at birth; This is our First Line Of Defense.
- **Acquired or specific:** It is not present at birth but becomes part of our immune system as the lymphoid system develops.
- 1970: WHO defined immunity as immune response to antigen ( Foreign body) in form of
- **Humoral** ( activation of B-lymhocytes)
- **Cellular** (by activation of T-lymphocytes)

# Cells Involved in Immunity

- Macrophages
  - B cells
  - T cells

# Leukocytes

white blood cells ~ WBC

agranular

granular

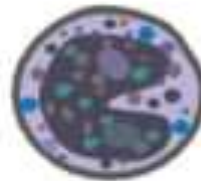
lymphocytes  
20 - 25 %

monocytes  
3 - 8%

basophils  
.5 - 1%

neutrophils  
60 - 70%

eosinophils  
2 - 4%



T-cell, B-cell, NK Cell

Monocyte



Neutrophil



Eosinophil



Basophil



Platelets



Macrophage



Erythrocyte



# Innate Immunity

# Innate Immunity

Defensive mechanisms include :

1) Innate immunity (Natural or Non specific)

2) Acquired immunity (Adaptive or Specific)



Cell-mediated immunity

Humoral immunity

# Component of Innate Immunity

## Innate Immune system

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graph TD; A[Innate Immune system] --> B[First line]; A --> C[Second line]; B --> B1[1) Mechanical barriers]; B --> B2[2) Chemical & biochemical inhibitors]; B --> B3[3) Normal flora]; C --> C1[A- cells]; C --> C2[B- Soluble factors]; C --> C3[C- Inflammatory barriers]; C1 --> C1_1[1- Natural killer]; C1 --> C1_2[2- Phagocytes];
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### First line

- 1) Mechanical barriers
- 2) Chemical & biochemical inhibitors
- 3) Normal flora

### Second line

#### A- cells

- 1- Natural killer
- 2- Phagocytes

#### B- Soluble factors

#### C- Inflammatory barriers

# Important components of innate immunity

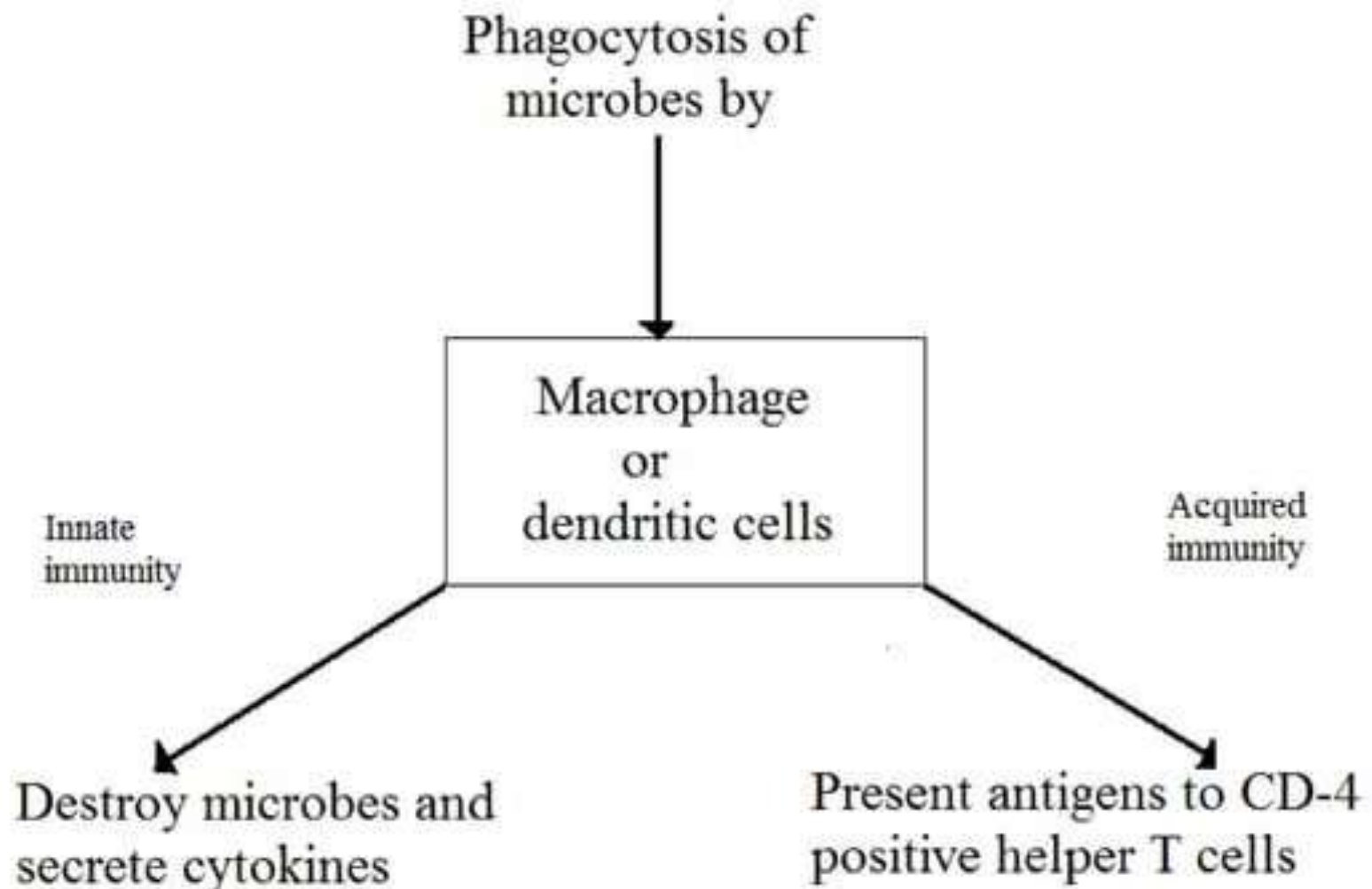
Factors that limit entry of microorganisms into the body

<u>Factor</u>	<u>Mode Of Action</u>
-Keratin layer of intact skin	-Acts as mechanical barrier
-Lysozyme in tears and other secretions	-Degrades peptidoglycan in bacteria cell wall
-Respiratory cilia	-Elevate mucus containing trapped organisms
-Low pH in stomach and vagina; fatty acids in skin	-Retards growth of microbes
-Surface phagocytes (eg. alveolar macrophages)	-Ingest and destroy microbes
-Defensins (cationic peptides) membrane	-Create pores in microbial
-Normal flora of throat, colon and vagina	-Occupy receptors which prevent colonization by pathogens

# Important components of innate immunity

## Factors that limit growth of microorganisms within the body

- Natural killer cells
- Neutrophils
- Macrophages and dendritic cells
- Interferons
- Complement
- Transferrin and lactoferrin
- Fever
- Inflammatory response
- APOBEC3G (apolipoprotein is RNA editing enzyme)
- Kill virus infected cells
- Ingest and destroy microbes
- Ingest and destroy microbes, and present antigen to helper T-cells
- Inhibit viral replication
- C3b is an opsonin, membrane attack complex creates holes in bacterial membranes
- Sequester iron required for bacterial growth
- Elevated temperature retards bacterial growth
- Limits spread of microbes
- Causes hypermutation in retroviral DNA and mRNA



Macrophages and other antigen presenting cells such as dendritic cells, participate in both the innate arm and acquired arm of the immune system. They are in effect a bridge between the two arms. As part of the innate arm they ingest and kill various microbes. They also present antigens to helper T cells which is the essential first step in the activation of the acquired arm.

**Main Components of Innate Immunity that contribute to humoral ( antibody-mediated ) immunity and cell mediated immunity**

	<b><u>Humoral Immunity</u></b>	<b><u>Cell mediated Immunity</u></b>
Innate	Complement Neutrophil	Macrophages Natural killer cells

# **Specificity Of The Immune Response**

- Recognition of the foreign organisms by specific immune cells
- Activation of these immune cells to produce a specific response (eg,antibodies)
- Response that specifically targets the organisms for destruction

# Major Functions Of T Cells and B cells

## **Antibody-Mediated Immunity (B Cells)**

- 1) Host defense against infection
- 2) (Opsonize bacteria, neutralize toxins and viruses)
- 3) Allergy (hypersensitivity) eg, hay fever anaphylactic shock
- 4) Autoimmunity

## **Cell Mediated Immunity**

- 1) Host defense against infection (especially M.tuberculosis, fungi and virus infected cells)
- 2) Allergy (hypersensitivity )eg poison oak
- 3) Graft and tumor rejection
- 4) Regulation of antibody response (help and suppression)

## **Important features Of Innate Immunity**

<b>Specificity</b>	<b>Effective immediately after exposure to microbe</b>	<b>Improves After Exposure</b>	<b>Has memory</b>
<b>Nonspecific</b>	<b>Yes in minutes</b>	<b>No</b>	<b>No</b>

# Active and Passive Immunity

- **Active immunity** is resistance acquired after contact with foreign antigens, eg, microorganisms
- This contact may consist of :
  - Clinical or subclinical infections
- Immunization with live or killed infectious agents or their antigens.
- Exposure to microbial products (eg, toxins and toxoids)

# Immunogen and Antigen

- When foreign substances (Ag) are introduced into the body, they lead to anti-foreign substance
- ( Anti-body ) formation
- **Immunogenic** when they are able to produce specific immune response; that they will stimulate immune cells and then give rise to immunological reaction (Humoral or cellular).
- **Antigenic** substances cannot directly yield immune response, but need some help by some proteins) and then
- They can react with antibodies.
- ***All immunogens are antigenic but not all antigens are immunogenic***

# Hapten

- Hapten is a greek word meaning to fasten. These are partial antigens. These are not immunogenic.
- Hapten needs carrier proteins like albumin, globulin and synthetic polypeptide to become immunogenic.
- Hapten (Hp)+Carrier Protein (Cp)  $\rightarrow$  Hp+Cp- $\rightarrow$  Ab formation against hapten
- Antibiotics, analgesics, penicilin and alpha-methyldopa
- Therefore haptens are antigenic and not immunogenic



**Thank you**