

# IMMUNOLOGY

## INTRODUCTION

# Introduction and Historical Background

## Immunology

**Immunity: The body's defense against a particular antigen, microorganism and cancer.**

### Historical background

First people observation.

**Chinese and smallpox infections 12<sup>th</sup> century.**

Europe followed Chinese in 1754 to treat rinderpest of cattle.

Nasal discharge-----string-----incision in dewlap

1798 Edward Jenner

--Pseudocowpox virus

--Cow poxvirus and small poxvirus

Cow pox-----scabs----man-----protection

## VACCINATION (Vacca=cow)

The method is used in 1970 to eradicate smallpox

1879 Louis Pasteur(France) prepared a vaccine against Fowl cholera by preparing an *old* culture of *P.multocida* -

----- Chickens inoculation----- Still healthy (no death)

He prepared also a vaccine against *Bacillus anthracis* -----  
grew at high temp. --- vaccination.

He was the first scientist who prepared a vaccine against rabies

Rabbit-----infected with rabies virus-----Spinal cord-----  
dry-----Vaccination.

In 1888 Yersin and Roux from Pasteur institution

Diphtheria Bacillus-----Bacterial toxins----mixed with  
antibodies-----Neutralization.

Serum rich with antitoxin antibody -----injected in  
animals-----Protection

- In 1890 Von Boehring and Kitasato from Koch Institute.
- Tetanus toxin----Inactivated by heat---  
Injected into horses---- Blood collection-----  
Serum separation-----Antibodies from serum  
injected in another horse---Challenged with  
the same bacterium----PROTECTION

# BODY DEFENSE MECHANISM

## 1-Non-specific defense mechanisms.

*(innate immunity) consists of the pre-existing defenses of an animal such as barriers and secretions.*

## 2-Specific defense mechanisms

Is a response to specific immune stimulants

That induce the stimulation and formation of specific cells and proteins play an important role in eliminating of that antigen fro the body.

# The immune system

**The immune system is:**

**Defense body mechanism an interacting set of specialized cells and proteins designed to identify and destroy foreign invader**

**The immune system must be able to: differentiate between material that is a normal component of the body (“self”) and material that is not native to the body “nonself” .**

**A highly specialized receptors present for discriminating between ”self” and “nonself” body components The discrimination between “self” and “non-self” and the subsequent destruction and removal of foreign material is accomplished by the two arms of the immune system**

# The immune system

1) The innate (natural or nonspecific) immune system

2) The adaptive (acquired or specific) immune system

\*These two systems perform many of their functions by cooperative interactions

# Immunity

- Innate immunity

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- Components

- Macrophages

- Granulocytes

- Natural killer cells

- Complement

- Other chemicals: HCL, lysozyme

- **Characteristics**

- \* Action is immediate

- \* Response is non-specific

- \* Response is not enhanced on

- repeated exposure to pathogen

- Adaptive immunity

- *Humeral and Cell-mediated*

- Components

- antigen presenting cells

- T-cells

- B-cells

- Antibodies

- Complement

- **Characteristics**

- \* Action requires days to develop

- \* Response is specific

- \* Response is enhanced on

- repeated exposure to pathogen



# Innate Immunity

# Innate Immunity

Defensive mechanisms include :

1) Innate immunity (Natural or Non specific)

2) Acquired immunity (Adaptive or Specific)

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graph TD; A[Acquired immunity] --- B[Cell-mediated immunity]; A --- C[Humoral immunity]
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Cell-mediated immunity  
immunity

Humoral

# 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];
```

### 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

# First line

## 1) Mechanical barriers

- Intact skin
- Mucous coat
- Mucous secretion
- Blinking reflex and tears
- The hair at the nares
- Coughing and sneezing reflex

# First line

## 2) Chemical & biochemical inhibitors

- **Sweet and sebaceous secretion**
- **Hydrolytic enzymes in saliva**
- **HCl of the stomach**
- **Proteolytic enzyme in small intestine**
- **Lysozyme in tears**
- **Acidic pH in the adult vagina**

# First line

## 3) Normal bacterial flora

- Competition for essential nutrients
- Production of inhibitory substances

# Second line

## A- cells

### 1- Natural killer (NK)

**Definition:** Large granular lymphocytes  
Innate cytotoxic lymphocytes

**Source** : Bone marrow precursors

**Location** : 10% or 15% of lymphocytes in **peripheral blood**  
1% or 2% of lymphocytes in **spleen**

**Function** : Cytotoxic for Tumor cells  
Viral infected cells  
Bacterial, fungal, parasitic infection

Responsible for → antibody-dependent cell mediated cytotoxicity

# Second line

## 2- Phagocytes

Specialized cells for capture, Ingestion and destruction of invading microorganisms

- \* Polymorphonuclear leucocytes, mainly **neutrophils**:  
granulocytes circulate in blood
- \* Mononuclear cells (**macrophages**)
  - Monocytes in blood
  - **Histocytes** in connective tissues
  - **Fixed reticuloendothelial cells** in liver spleen,  
lymph



# Second line

## B- Soluble factors

- 1- Acute phase protein** (Plasma protein, CRP=C reactive protein, Fibrin.)
- 2- Complement** (proteins in serum, body fluids)
- 2- Interferons** (Proteins against viral infections)
- 3- Properdin** (Complement activation)
- 4- Beta lysine** (Antibacterial protein from Platelets)
- 5- Lactoferrin, Transferrin** (Iron binding protein)
- 6- Lactoperoxidase** (Saliva & Milk)
- 7- Lysozyme** (Hydrolyze cell wall)

# Interferons

Proteins usually produced by virally infected cells

## \* Types of interferons:

- |                     |                           |  |
|---------------------|---------------------------|--|
| 1- Alpha interferon | Secreted by<br>Induced by | Macrophages<br>Viruses or Polynucleotide |
| 2- Beta interferon  | Secreted by               | Fibroblasts, Viruses                     |
| 3- Gamma interferon | T- lymphocytes,           | Specific antigens                        |

# Interferons

## Protective action of interferons:

- 1) Activate T-cells
- 2) Activate macrophages
- 3) Activate NK

# Phagocytosis

The engulfment, digestion, and subsequent processing of microorganisms by macrophages and neutrophils

## 1) Chemotaxis & attachment:

a- Attraction by chemotactic substances (microbes, damaged tissues)

b- Attachment by receptors on surfaces of phagocytes

# Phagocytosis

## 2) Ingestion:

- \* Phagocyte pseudopodia surround organism forming phagosome
- \* Opsinins and co-factors enhance phagocytosis
- \* Fusion with phagocyte granules and release  
digestive, toxic contents

# Phagocytosis

## 3- Killing (two microbicidal routes)

a- Oxygen depended system (powerful microbicidal agents)

Oxygen converted to superoxide, anion, hydrogen peroxide, activated oxygen and hydroxyl radicals.

b- Oxygen-independent system (anaerobic conditions)

Digestion and killing by lysozyme. Lactoferrin, low pH, cationic proteins and hydrolytic and proteolytic enzymes

# C) Inflammatory Barriers

\* Tissue damage by a wound or by invading pathogen

\* Inflammatory response:

Release of chemical mediators from

(Histamine, fibrin, kinins, cytokines)

Tissue damage

Leukocytes

Invading microbe

Vasodilatation of capillaries

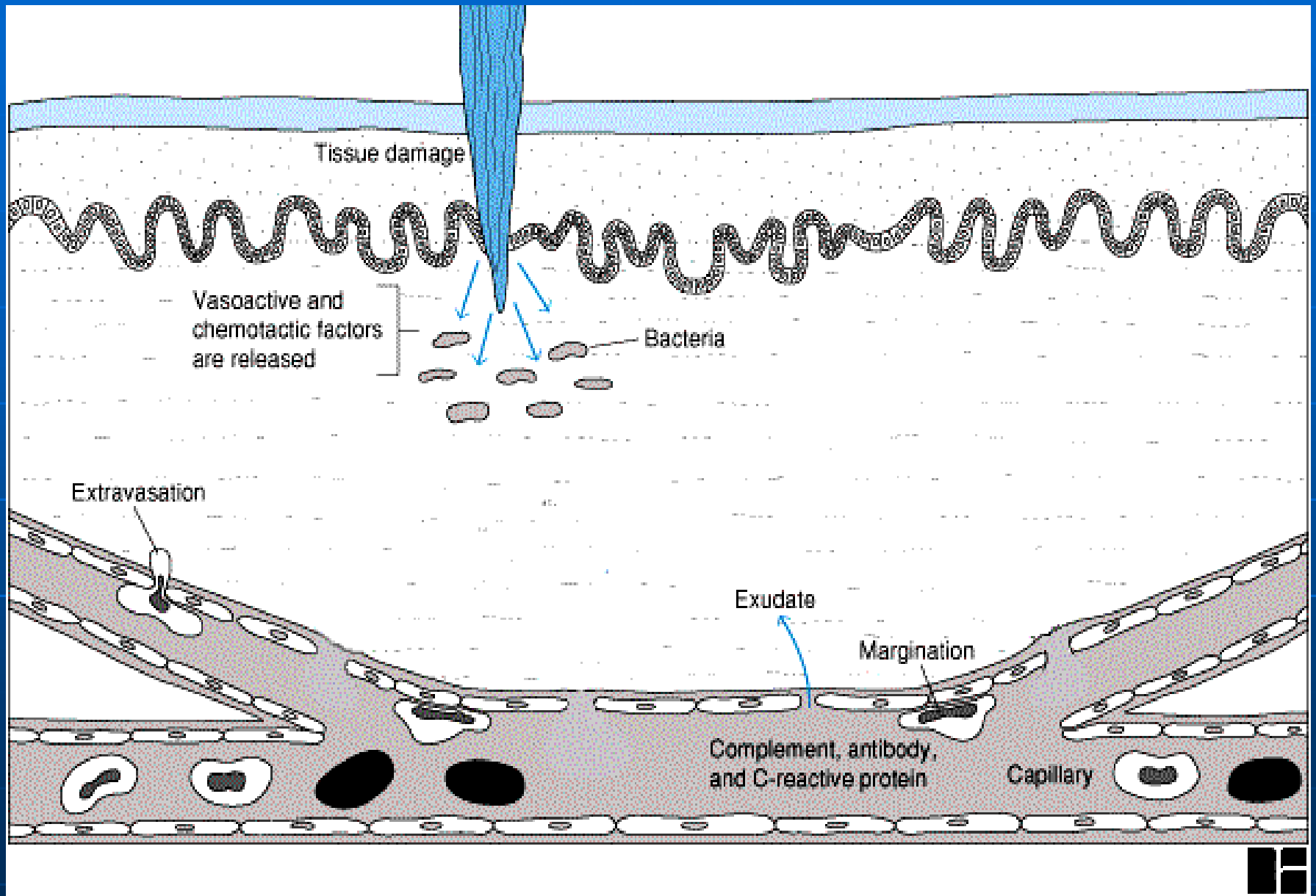
Redness of tissue

Tissue temperature

Capillary permeability

Influx of fluids

Influx of phagocytes  
into tissues





*Thanks*