Colleg of Applied medical sciencs // second years // first semester

General Immunology Lect.1 10/10 2018

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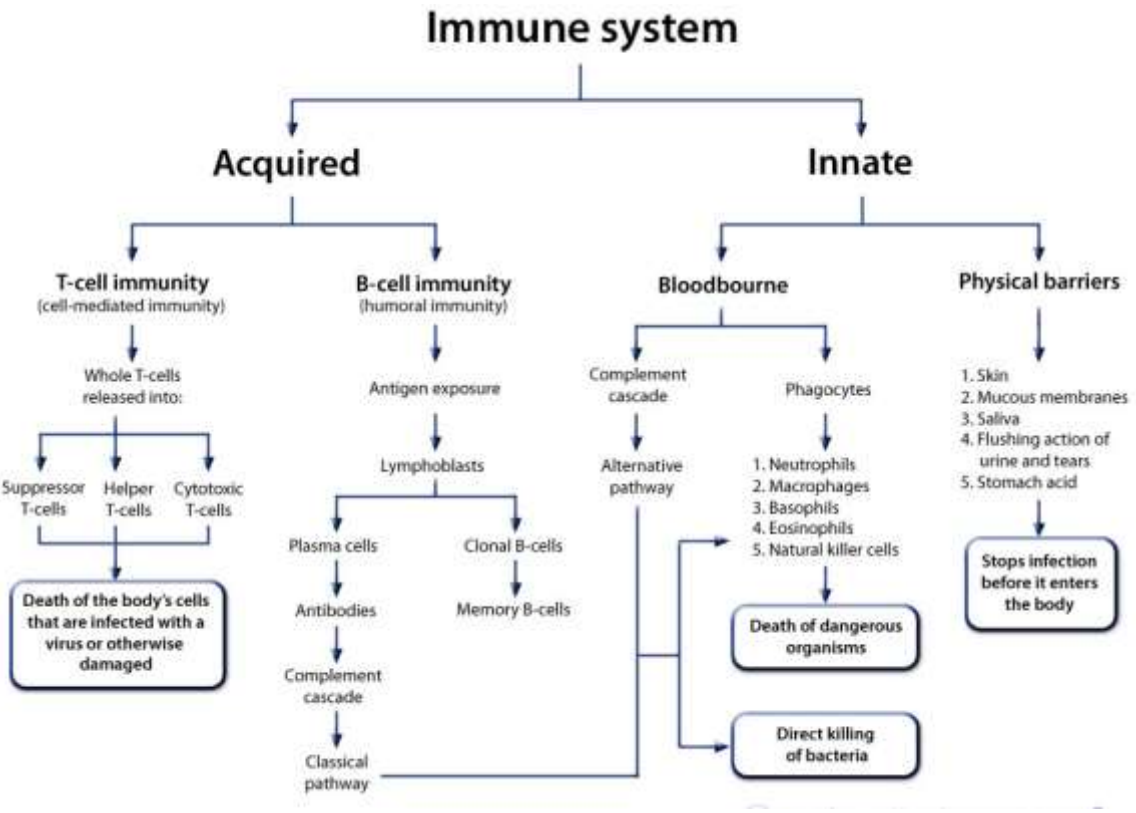
Immunology

Immunology: **:**The science which studying the physiological functioning of the immune system in states of both health and patient .
and study the relation ship between immune system & pathogen or antigen (Ag) .
and study all aspects of the immune system in to recognition of self and non self antigen,

Branch's of immunology:

- 1- Immunochemistry: which studies the chemical nature of antigen and antibody and immuno modulator.
- 2-Immunobiology: Which studying the immune organs which sharing in immune response.
- 3-Immunogenetic: Which studying the heredity of the immune gene locks in the chromosome and the auto immune disease which related genetically.
- 4-Serology which studying the reaction between antigen and antibody *in vitro* which using in diagnosis of deferent diseases.
- 5-Oral immunity: new branch which studying the mechanical and chemical immune defiance in the limited pH. In the oral cavity.



Innate and adaptive immunity

Innate immunity :Non-antigen specific host defenses that exist prior to exposure to an antigen and involve anatomic, physiologic, phagocytic, anti-microbial, and inflammatory mechanisms, and which exhibit no adaptation or memory characteristics.

provides the early line of defense against microbes. It consists of cellular and biochemical defense mechanisms that are in place even before infection and are poised to respond rapidly to infections. The principal components of innate immunity are

(1) physical barriers such as skin & epithelia surface.

(2)chemical barriers such as antimicrobial chemicals produced at epithelial surfaces; (stomach & nasopharyngeal exudate) .

(2) phagocytic cells (neutrophils, macrophages), dendritic cells, and natural killer (NK) cells and other innate lymphoid cells;

(3) blood proteins, including members of the complement system , CRP and 4- other mediators of inflammation

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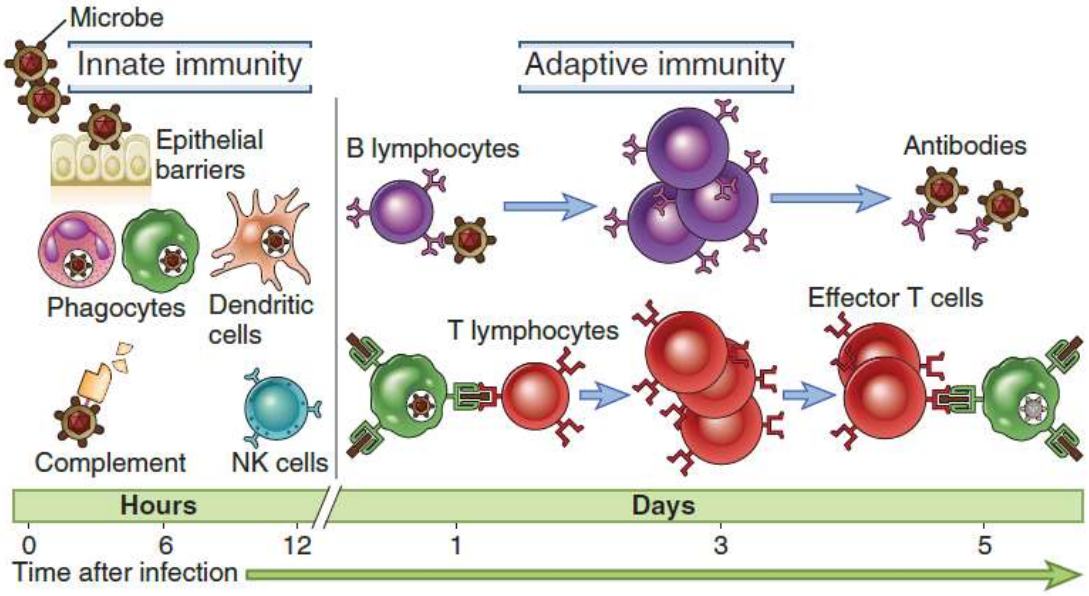


Adaptive (Acquired) immunity. Host defenses that are mediated by B cells and T cells following exposure to antigens(Ag) and that exhibit specific immune response which characterized with (specificity, diversity, memory, and self-non self discrimination.

Requires expansion and differentiation of lymphocytes in response to microbes before it can provide effective defense; it adapts to the presence of microbial invaders. **It have two mechanisms**

Humoral immunity is mediated by molecules in the blood and mucosal secretions, called **antibodies**,(Ab) which are produced by cells called **B lymphocytes** (**B cells**).

Humoral immunity is the principal defense mechanism against extracellular microbes For example, (bacteria & parasite) and their toxins because secreted antibodies can bind to these microbes and toxins and assist in their elimination.

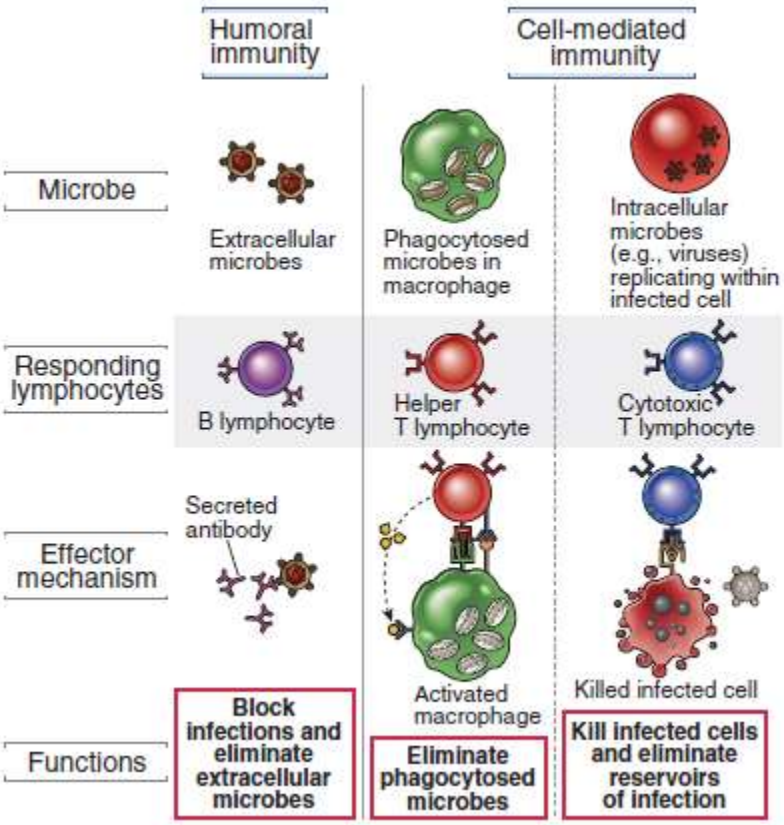
Humoral Immunity: Activation of B Lymphocytes and Elimination of Extracellular Microbes.

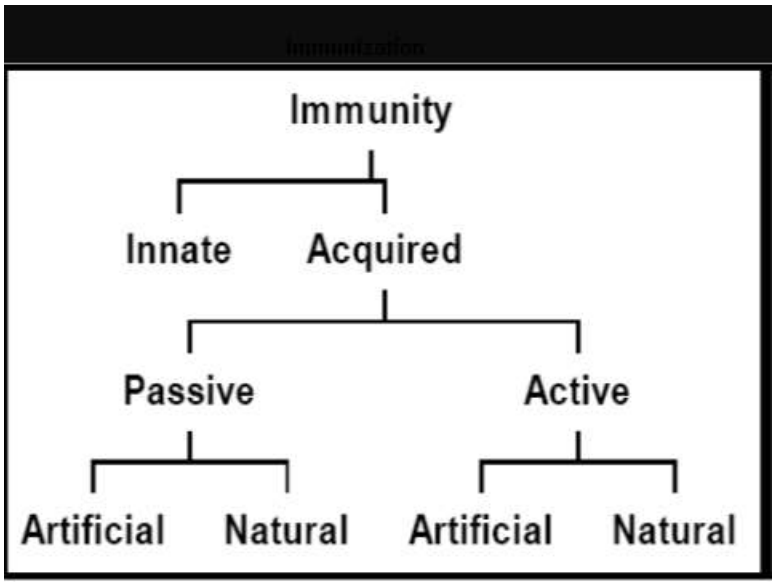
Extracellular microbes On activation, B lymphocytes proliferate and then differentiate into plasma cells that secrete specific classe of antibodies with distinct functions.

Cell-mediated immunity, also called **cellular immunity**, is mediated by **T lymphocytes** (**T cells**). Host defenses that are mediated by antigen-specific T cells. It protects against intracellular bacteria, viruses, and any body cells absent to (MHC) like cancer cells and also responsible for graft rejection. Transfer of by T cells confers this type of immunity on the recipient**.**

Celluler Immunity: Activation of T Lymphocytes and Elimination of Intracellular Microbes **and any body cells don't have or absent to Major Histocompatibility Complex (MHC)*.***

Intracellular microbes, which promotes the destruction of microbes residing in phagocytes or the killing of infected cells to eliminate reservoirs of infection. Some T lymphocytes also can contribute to eradication of extracellular microbes by recruiting leukocytes that destroy these pathogens and by helping B cells make effective antibodies.





Foe example

1-Naturally active acquired immunity: Exposure to different pathogens leads to sub clinical or clinical infections, which result in a protective immune response against these pathogens.

*2-Artificially active acquired immunity: **Immunization** may be achieved by administering live or dead pathogens or their components. **Vaccines** used for active immunization consist of live (attenuated) organism, killed whole organism, microbial components or **secreted toxins (detoxified).***

*3-Naturally passive acquired immunity: **Immunity is transferred from mother to fetus through placental transfer of IgG or colostral transfer of IgA.***

*4-Artificially passive acquired immunity: Immunity is often artificially transferred by injection with gamma globulins animal (**diphtheria, tetanus .**), poisoning (**insects, reptiles**, and as a prophylactic measure (**hypogammaglobulinemia).***

Passive transfer of cell-mediated immunity can also be accomplished in certain diseases (cancer, immunodeficiency).

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Innate immunity

Comprises four types of defensive barriers/mechanisms:

a-Anatomical
b-Physiological
c-Phagocytic/endocytic
d-Inflammatory

A-Anatomical

1- Mechanical barrier retards entry of microbes

2- Competition for attachment and nutrients

3- Hairs, Mucus entrapment & Cilia propulsion

b-Physiological

1- Temperature 37 ^{0}C and fever

2-Low pH Acidic environment (pH3-5) retards growth of microbes Mucosal surfaces and Acidity of stomach contents

3- Chemical mediators e.g. Lysozyme, Interferon, Complement, Cytokines.

c-Phagocytosis Phagocytic/endocytic

Carried out by specialised cells to internalise, kill/destroy/digest particulate matter

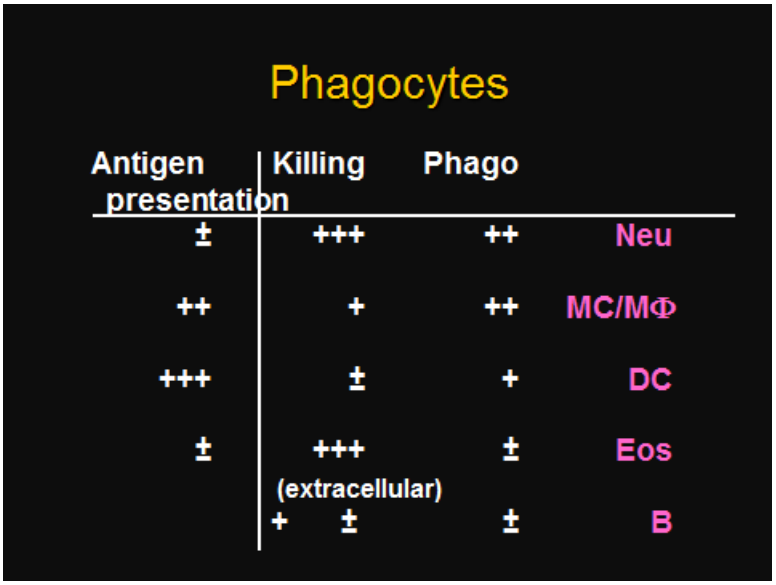
1- Neutrophils

2-Monocytes/Macrophages

3- Dendritic cells

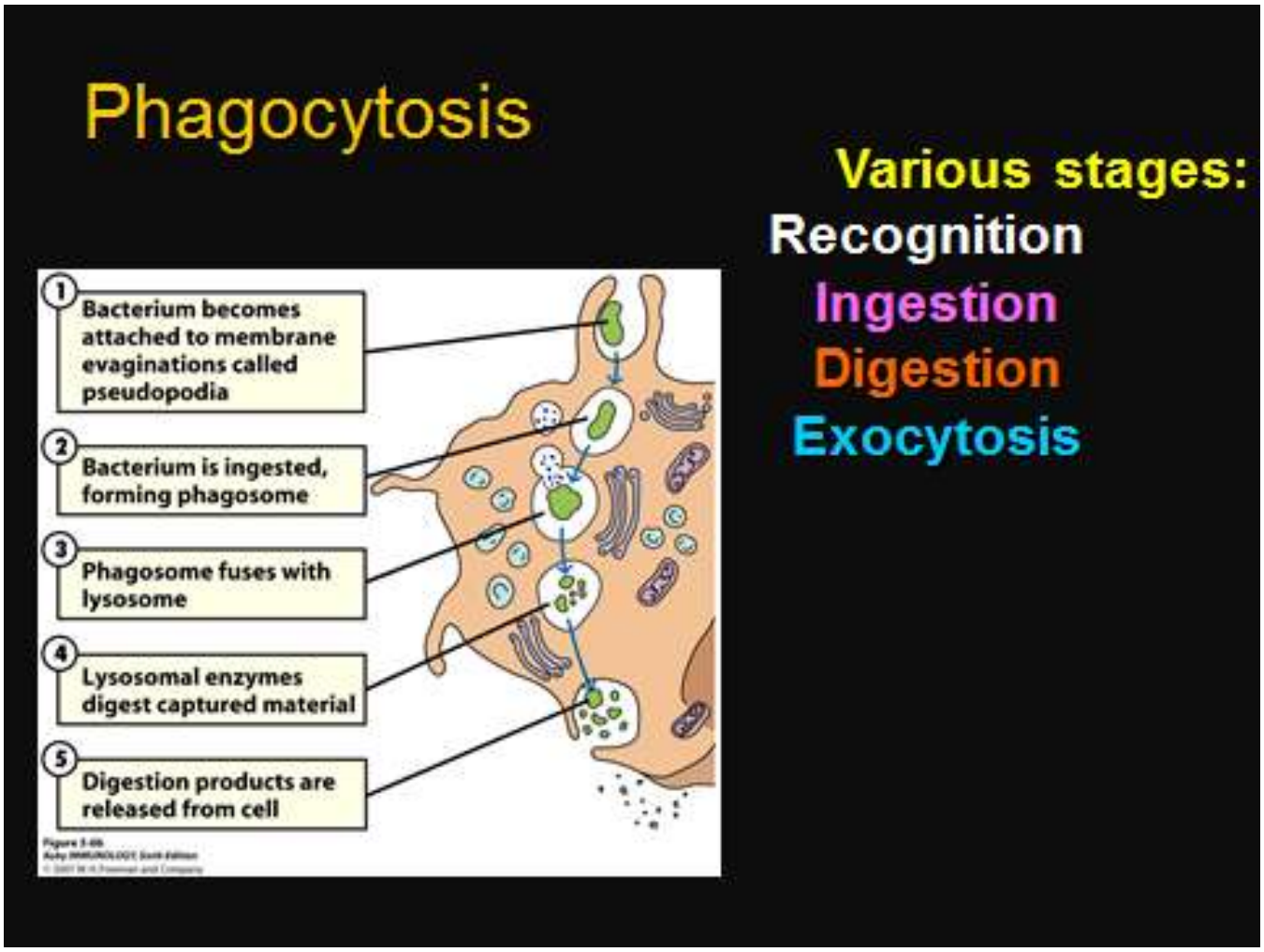
4-Eosinophils -

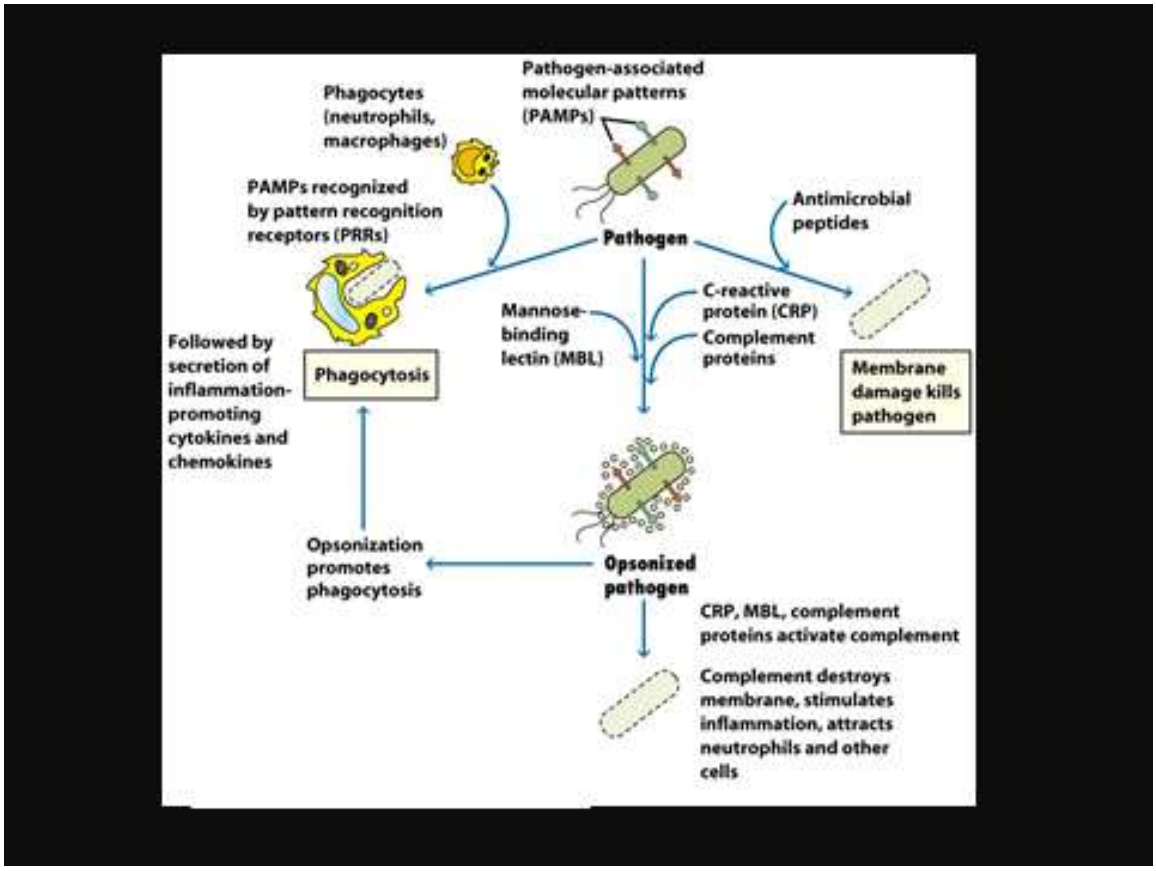
5-B cells



Phagocytosis

The cellular uptake of particulate materials by engulfment; a form of endocytosis. Despite the strong defenses of our protective epithelial layers, some pathogens have evolved strategies to penetrate these defenses, and epithelia may be disrupted by wounds, and insect bites that may transmit pathogens.





Intracellular killing

Digestion

Most mechanisms split into oxygen dependent and oxygen independent

Some breakdown products reused, others exocytosed, some stored until cell death

Oxygen Independent

- Acidification
- Lysozyme
- Other enzymes
- Defensins
- Lactoferrin
- Cationic proteins
- Tumour necrosis factor α

Oxygen Dependent

- Reactive oxygen intermediates
- Reactive nitrogen intermediates

Respiratory burst

Oxygen dependent 'Respiratory burst'

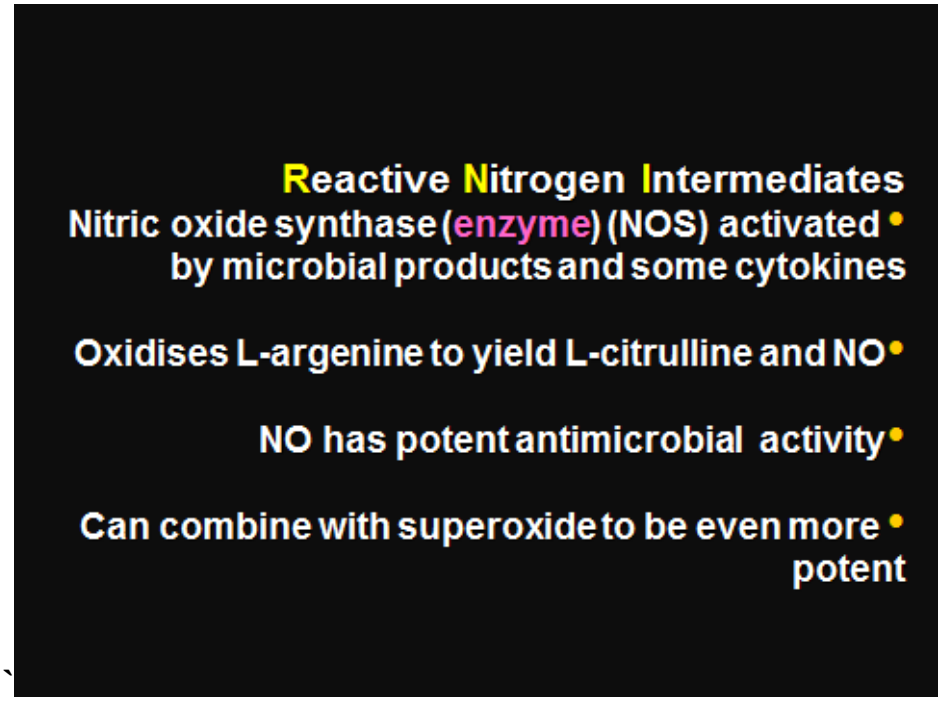
Activated phagocytes produce 'free-radicals'

Reactive **O**xygen **I**ntermediates

rapid increase in O_2 consumption

Involves cytoplasmic & membrane associated enzymes: (NADP-oxidase)

O_2 converted to superoxide anion – 2 unpaired e-s



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d-Inflammation :-is a protective response involving host cells, blood vessels, and proteins and other mediators that is intended to eliminate the initial cause of cell injury, as well as the necrotic cells and tissues resulting from the original insult, and to initiate the process of repair.

Components of both the innate and adaptive immune systems may respond to certain antigens to initiate a process known as inflammation.

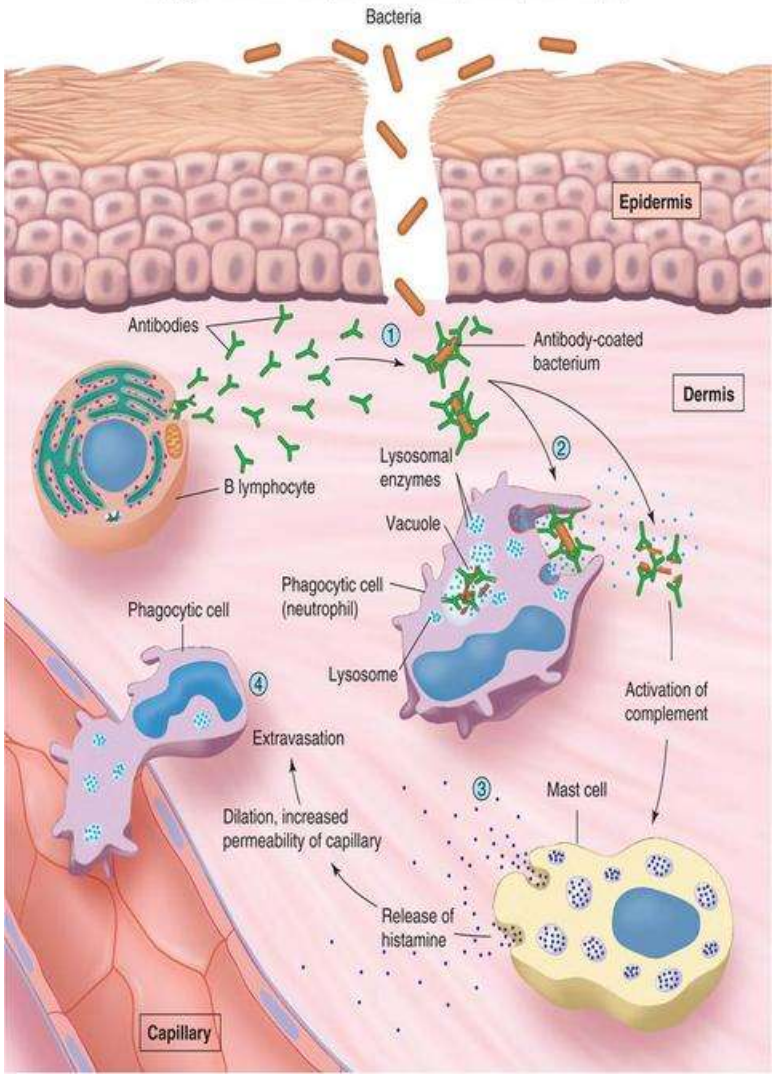
The cardinal signs of inflammation are pain , heat , redness , swelling (tumor) , and loss of function.

Enlarged capillaries that result from vasodilation cause redness (erythema) and an increase in tissue temperature. Increased capillary permeability allows for an influx of fluid and cells, contributing to swelling (edema) .

Phagocytic cells attracted to the site release lytic enzymes, damaging healthy cells. An accumulation of dead cells and fluid forms pus, whereas mediators released by phagocytic cells stimulate nerves and cause pain .

Inflammatory mediators

- Include a wide range of proteins, lipids and chemicals
- Mainly produced by mast cells & basophils but also neutrophils, eosinophils macrophages & platelets
- Additionally, plasma has 4 interconnected mediator producing systems: kinin, clotting, fibrinolytic and complement



Complement

Complement (C): group of serum and cell surface proteins which:

- **lyse cells & microorganisms**
- **act as opsonins to increase phagocytosis**
- **regulate inflammatory & immune responses**

Components present as inactive precursors in blood

Complement activation pathways

Three major pathways:

Classical

Alternative

Lectin

Self study

To learn the 3 complement cascades and formation of the membrane attack complex…)