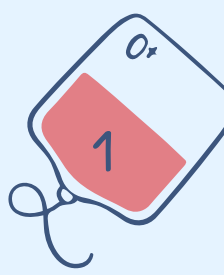
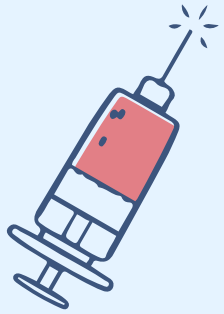


MED441
KING SAUD UNIVERSITY



Introduction to Immunology & Lymphoid System

Revised & Reviewed
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Colour index:

Main text

IMPORTANT

Drs notes

Females slides

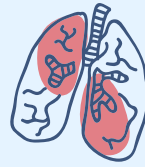
Male slides

Extra

Foundation block  Editing file

Objectives:

- To know the historical perspective of immunology.
- To be familiar with the basic terminology and definitions of immunology.
- To recognize immune response cells.
- To understand types of immune responses.
- To know about the lymphoid system.
- To understand T and B cell functions.



A Historical Perspective of Immunology

- **Immunity:** the state of **protection** against foreign pathogens or substances (antigens)
- **Word origin:** Immunity (Latin: Immunis)
 - Meaning: **exempt or free**
- **Observations of immunity** go back over 2000 years
 - Thucydides (ancient historian) wrote in 430 BC of a plague in Athens where those who had recovered could **safely** nurse the currently ill (they had resistance/immunity)

Can we generate Immunity without inducing disease?

- Yes, through **vaccination:**
 - Prepares immune system to eradicate an infectious agent **before** it causes disease
- Widespread vaccine use has saved many lives
- Examples:
 - Rabies vaccine
 - Eradication of smallpox (الجدري)

Disease	ANNUAL CASES/YR: Prevaccine	CASES IN 2016: Postvaccine	Reduction (%)
Smallpox	48,164	0	100
Diphtheria	175,885	0	100
Measles	503,282	79 ^A	99.98
Mumps	152,209	145 [*]	98.90
Pertussis ("whooping cough")	147,271	964 [*]	99.35
Paralytic polio	16,316	0	100
Rubella (German measles)	47,745	0 [*]	100
Tetanus ("lockjaw")	1,314 (deaths)	1 [*] (case)	99.92
Invasive <i>Haemophilus influenzae</i>	20,000	356 [*]	98.22

Cases of selected infectious disease in the US before and after the introduction of effective vaccines.

- The effectiveness of a vaccine can be measured by comparing the number of annual cases per year before and after vaccination
- They tried vaccinations before even knowing the components of the immune system

Louis Pasteur's Contributions:

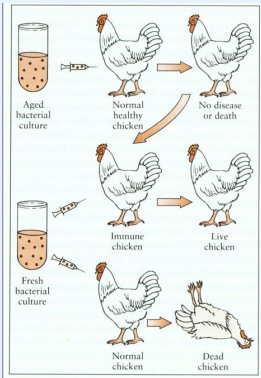
Pasteur exposed sheep with weakened anthrax bacillus (heated) so the sheep will gain immunity and survive.

Studied cholera in chickens

Determined that the virulence of a pathogen **weakens with age**

Observed that chickens inoculated with **old strains** not only survive, but become **resistant**

Louis Pasteur



Attenuated: weakened, non-virulent strain whose exposure can confer resistance to disease

Classical Experiment:
Heat **attenuated** anthrax bacillus and subsequent challenge with **virulent** *Bacillus anthracis* in sheep



Definitions:

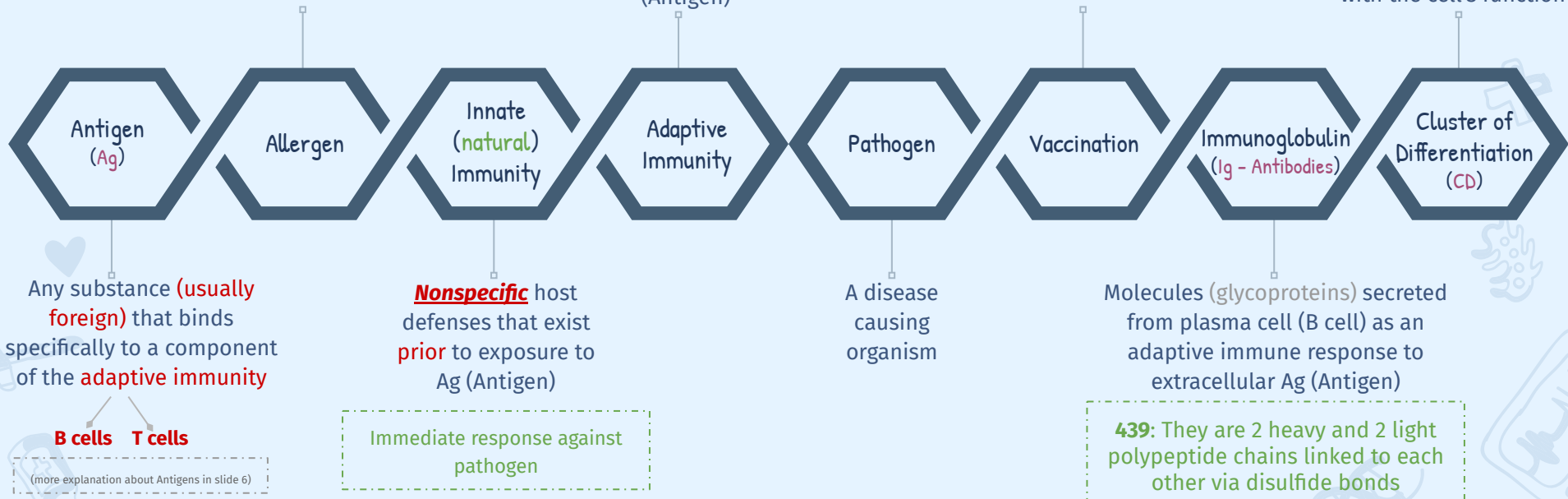
439: Under microscope we **cannot** distinguish between B and T lymphocytes, so we study the **proteins on the surface** to identify them.

Molecule with a CD designation has a characteristic **cell surface protein** which are often associated with the cell's function

Deliberate induction of protective immunity to a **pathogen**

Specific host defenses that are mediated by **T & B cells** following exposure to Ag (Antigen)

Noninfectious antigens that induce allergy



Where and What are Antigens?

★ Team 438

1 Microorganisms & their related products

Proteins - polysaccharides - lipids

2 Environmental substances

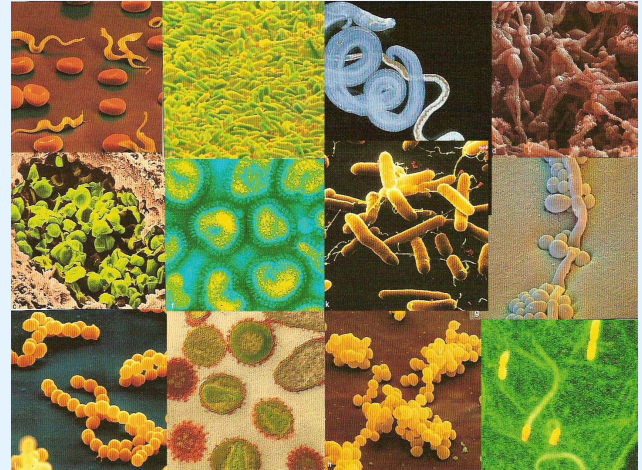
(Pollens, soil component)

3 Drugs

(Allergic reaction against certain drugs)

4 Organs (organ transplant), tissues, cells

There's a difference between **antigens** and **immunogens**. Not all antigens induce an immune response. Antigens that induce an immune response are called immunogens. **So all immunogens are antigens but not all antigens are immunogens.**



Lymphocyte Populations



- Markers are used to distinguish lymphocytes.
- Lymphoid series comprise of main lymphocyte populations

T Cell Markers

B Cell Markers

Natural Killer Cell Markers (NK)

CD3
In all T cells

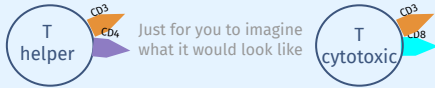
CD4
In T helper cells only

CD8
In T cytotoxic cells only

CD19

CD16

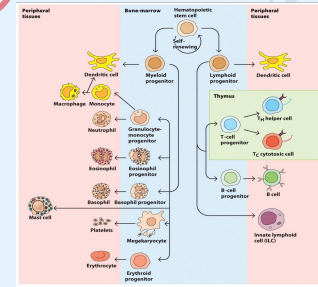
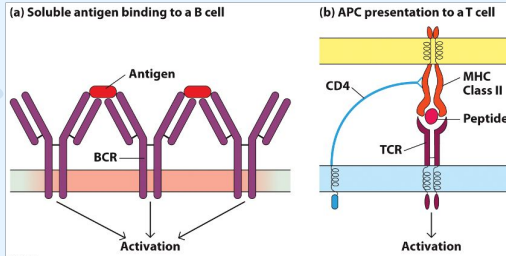
CD56



Cells of the Immune system

B cells
Also express the B cell receptor (BCR)

T cells
Also express the T cell receptor (TCR)



Types of Immunity

Innate (Natural) Immunity

Nonspecific host defenses that exist **prior** to exposure to Ag (Antigen)

- **First** line of defense
- **Fast, non-specific**
- **Shorter** duration
- Uses phagocytic cells
- **No** memory

AbMI: Antibody mediated immunity
Humoral means fluid (Latin)

439: Further explanation:
1- Antibodies are produced by (B-lymphocytes)
2- Antibodies are found in body fluid (blood and lymph)

Adaptive (Acquired) Immunity

Specific host defenses that are mediated by **T** & **B** cells **following** exposure to Ag (Antigen)

- Response of a specific B and T lymphocytes to an antigen
- Exhibit Immunological **Memory**
- **Self / non-self recognition**
- **Slower** to develop (5-6 days or more)

Humoral immunity (**AbMI**)

Immunity that is mediated by antibodies (**B cells**).
Response takes place in **blood and lymph**

More details in lecture 4

Cell Mediated Immunity (**CMI**)

Immune response in which antigen specific **T cells** dominate.
Response takes place **inside** the cell

More details in lecture 3

Innate and **Adaptive** immunity work **cooperatively**:

Activation of **innate** immune responses produces signal molecules (**cytokines**) that stimulate and direct adaptive immune responses.

439: Recognize whether the body (antigen) is from **inside or outside** the body.
When Antigen is from **inside** the body it's called: **Autoimmune disease**

Lymphoid System

Lymphatic Vessels

Lymphoid Organs

Primary Lymphoid Organs

Secondary Lymphoid Organs

Development & Differentiation of immune cells

Where the immune response occurs

Bone Marrow

Thymus

Tonsils

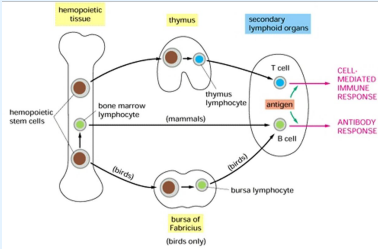
Peyer's patches

Lymph Nodes

Appendix

Spleen

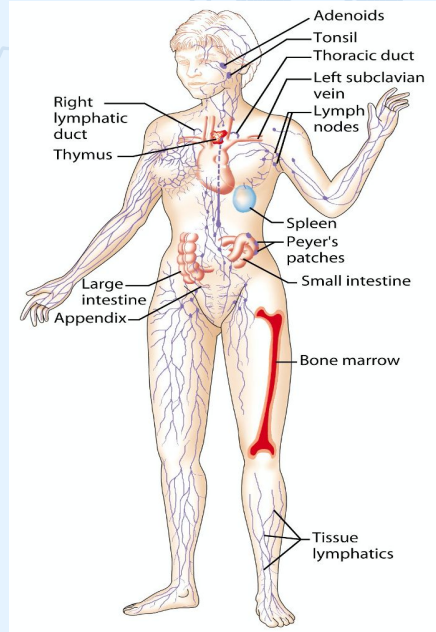
MALT (Mucosa Associated Lymphoid Tissue)



The most highly organized secondary lymphoid organs

The first line of defense against blood-borne pathogens

Important layer of defense against infection at mucosal and epithelial layers



- Differentiation into effector cells takes place in follicles of **secondary** lymphoid organs.
- Both **B** and **T** lymphocytes will develop into **long-lived** memory cells in these areas, as well.

T - Lymphocyte Differentiation

1 **Origin:**
Bone Marrow

2 **Migrate to:**
Thymus (for development)
(Only **CD3** markers)

3 **Differentiation:**

- During their differentiation, they differentiate into **T** cells expressing **either** markers (**CD4** T helper cell or **CD8** T cytotoxic cell) **but not both!**
- **ALL** of **T** cells have **CD3** protein on their cell surface

439:

- ★ **B** cells -> Bone marrow (mature)
- ★ **T** cells -> Bone marrow (immature) -> Thymus (maturation)

T cell precursors differentiate into mature **T** cells in **Thymus**

T - Lymphocytes

T helper lymphocytes (CD4+)

Th1

Inflammatory **T** helper cells:

- Mediates inflammation via helping macrophages in **CMI** (cell mediated immunity) during inflammatory response.
- Helps **CD8+** cells to become activated cytotoxic **T** cells.

Th2

Helps B cell to produce antibodies (Humoral Immunity)

Th17

Has a role in **innate Immunity** & the pathogenesis of autoimmune diseases.

T(reg)

Represses the growth and function of T cell helper and cytotoxic subsets. (**Regulatory T cells**)

Tfh

T follicular helper are critical to prevent autoimmunity.

T cytotoxic lymphocytes (CD8+)

- About **35%** of peripheral blood **T** cells
- Perform cytotoxic functions
- They mediate the killing of:
 - **Virus-infected cells**
 - **Tumors**
 - **Allograft cells (transplant)**

B - cells

Origin

- During embryogenesis – fetal liver (**before birth**)
- Migrate to bone marrow – final destination (**after birth**)
- They **do not require** thymus for maturation

B cell progenitors

- **Pro-B** cells, **Pre-B** cells and **immature B** cells are normally found in **bone marrow**

Mature B cells

- Mature **B** cells:
- Mature B cells are found circulating in **body fluids** (blood, lymphatic fluid) and **lymphoid organs**
 - **IgM** (immunoglobulin M)
 - **IgD** (immunoglobulin D)which serve as **antigen receptors** (Maturation Markers)

The Good, Bad, and Ugly of the Immune System

Role of the Immune System:



Protection

Abnormal Immune System



Dysfunction of the protection role of the Immune System

Overly active Immune System →
Hypersensitivity /
Autoimmunity

Defects in immune response
(Immunodeficiency)

Rejection of transplanted tissue or organ

Cancer



Take Home Messages

1

Normal healthy state is maintained by intact immune response either innate (natural immunity) and/or adaptive (acquired immunity after exposure to antigens).

2

Cell mediated immunity and humoral immunity is mediated by T and B lymphocytes respectively.

3

Lymphoid system provides suitable environment for development, maturation and proper functioning of cells of immune system.

MCQs

Q1: Humoral immunity is mediated by

A- T lymphocytes

B- Macrophages

C- B lymphocytes

D- Natural killer cells

Q2: T cell precursors differentiate into mature T cells in

A- Thymus

B- Bone marrow

C- Lymph nodes

D- Spleen

Q3: Which type of marker in T helper cells only

A- CD25 markers

B- CD4 markers

C- CD8 markers

D- CD56 markers

Q4: Which type of marker that All T cells have it

A- CD8 markers

B- CD25 markers

C- CD4 markers

D- CD3 markers

Q1-C, Q2-A, Q3-B, Q4-D

MCQs

Q5: Which of the following is not true about the innate immunity?

A- Fast

B- Uses phagocytic cells

C- Nonspecific

D- Has immunological memory

Q6: Which of the following helps B cells to produce antibodies?

A- Th1

B- Th2

C- Th17

D- Threg

Q7: The first line of defence against blood-borne pathogens is:

A- Tonsils

B- Lymph Nodes

C- Spleen

D- Appendix

Q8: Noninfectious antigens that induce allergy:

A- Allergen

B- Antigen

C- Pathogen

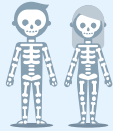
D- Antibody

Q5-D, Q6-B, Q7-C, Q8-A

★ Special thanks and gratitude to
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