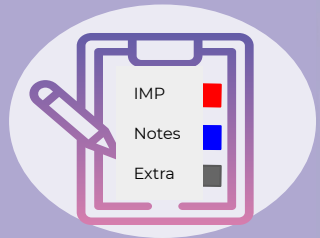
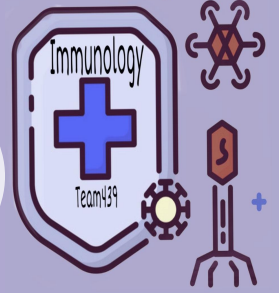
Antibody-mediated immunity





Objectives

01

To describe B-cells as the mediators of humoral immunity, (antibody-mediated immunity)

02

To describe activation of B-cells which involve: a. Antigen recognition b. T dependent & T- independent antigen c. requirement for T-helper cells

03

To explain clonal selection, clonal expansion & and generating of plasma cells & memory cells

04

To describe primary and secondary immune responses

05

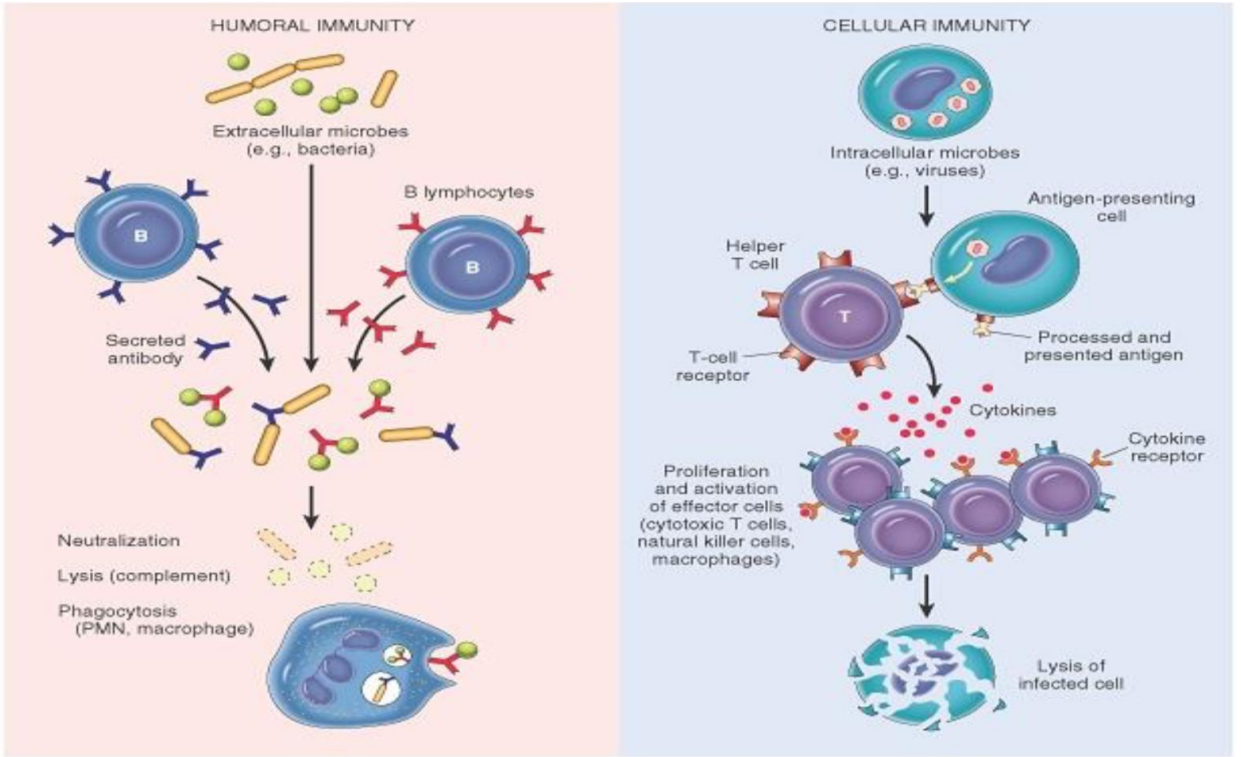
To describe the structure & function of immunoglobulins

- **The Humoral Immune Response:** is the aspect of immunity that is mediated by secreted antibodies.

- Humoral immunity is so named because it involves substances found in the: **humoral (body fluids)**

Nature of antigen determine type of response either

Extracellular or Intracellular



in T independent antigen no generation of memory cell, very quick reaction

1.T-dependent antigens:

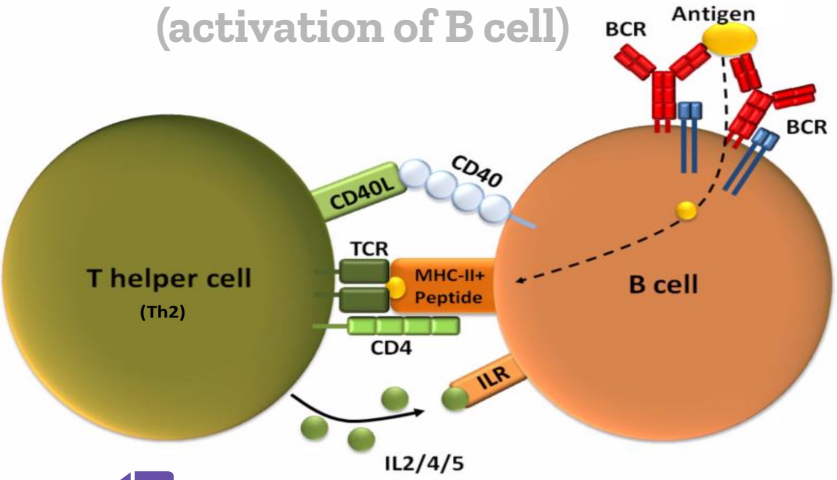
- Antibody production by B-cells **require** T-helper cells (Th2)
- Antigen presenting cells recognize antigen & present it to T-helper cells
- T-helper cells stimulate B-cells specific for that antigen to become **plasma cells**
- T-dependent antigen are mainly **proteins** on viruses, bacteria & other foreign material

Activation of B-cells by antigen

1.T-independent antigens:

- B-cells **do not** require T-helper cells to produce antibody
- Antigen are mainly **polysaccharides** or **lipopolysaccharides** with repeating subunits (bacterial capsules)
- Immune responses induce the production of IgM of **low affinity** for the antigen and **no immunologic memory**

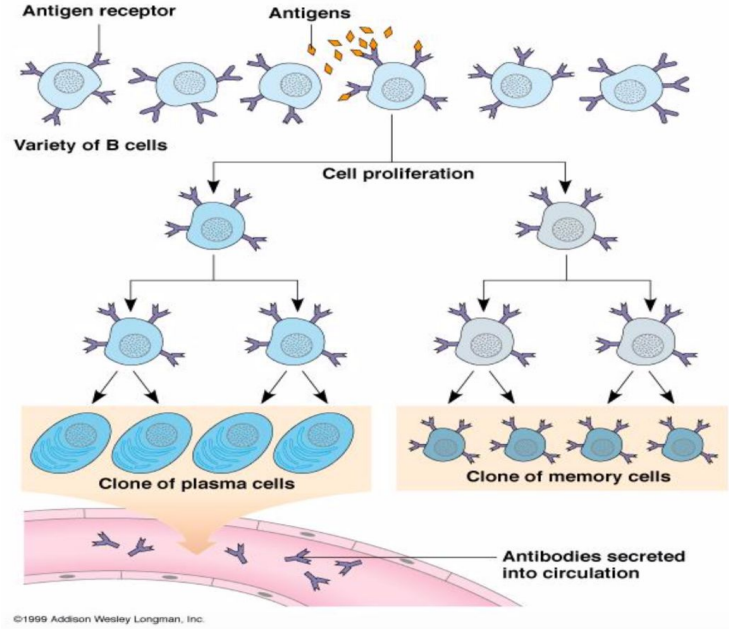
T-dependent antigen
(activation of B cell)



- Th1 is a CD4 cell which promotes cell mediated immunity (cellular immunity)
- Th2 is a CD4 cell which promotes Antibody mediated immunity (humoral immunity) which will be covered in this lecture

- Cell activation leads to
  a. proliferation
  b. Release of cytokines (lecture 2)

Clonal selection and Clonal proliferation



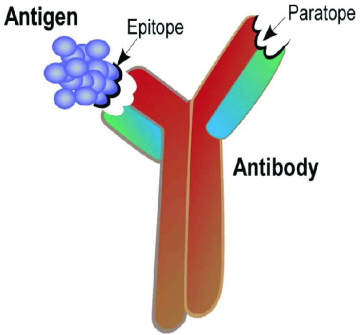
B-cells are activated by the binding of antigen to specific receptor on its surface, which stimulates the cell to divide and proliferate (multiply very fast).
in the end production of plasma cells and memory cells

Antibodies

Each B-cell (antibodies) recognize only one epitope

Epitope--->binding site of antigen

Paratope--->binding site of antibody interacting with the epitope on antigen.



Antibodies are immunoglobulins with specific function

Antibodies bind to specific site on antigen surface called **epitopes** and perform protective functions by different mechanism

There is a **SPECIFIC** antibody for any one given type of an antigen

Healthy E.coli

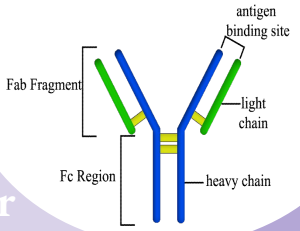
Antibody + complement-mediated damaged to E.coli

Have the shape of a letter “ Y “

Made up four polypeptide chains

Two longer and larger (heavy chains) and the other two shorter and smaller (light chains)

Antibody structure



Variable region has the potential to bind with particular classes of antigens

Once a raw antibody is stimulated to fit to a specific antigen, it can then react with ONLY that antigen

This is known as SINGLE SPECIFICITY

Can fit as precisely as a lock-and-key to an antigen

Protective function of Antibodies

Binding of antibodies to antigens inactivate antigen by

Classical pathway is triggered by antigen-antibody complex

MEMORIZE THE TYPES

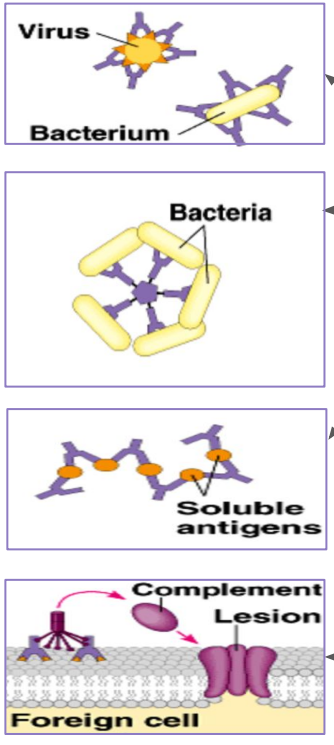
Neutralization (blocks viral binding sites; coats bacteria and/or opsonization) ENHANCE PHAGOCYTOSIS ex; hepatitis virus

Agglutination*
of antigen-bearing particles, such as microbes.
ENHANCE PHAGOCYTOSIS

Agglutination: when the antibody connect with the antigen and the clumping can be seen directly

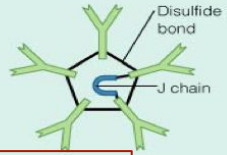
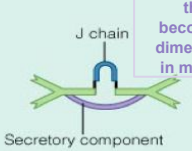
Precipitation of soluble antigens. (Same as agglutination but the antigen is very small and can't be seen directly)
ENHANCE PHAGOCYTOSIS

Complement fixation (activation of complement)
LEADS TO CELL LYSIS



Summary of Immunoglobulin Classes

Found as monomeric in serum, then becomes a dimer "IgA" in mucous

Characteristics	IgG	IgM	IgA	IgD	IgE
					
Structure	Monomer	Pentamer	Dimer (with secretory component)	Monomer	Monomer
Percentage of total serum antibody	80%	5–10%	10–15%*	0.2%	0.002%
Location	Blood, lymph, intestine	Blood, lymph, B cell surface (as monomer)	Secretions (tears, saliva, mucus, intestine, milk), blood, lymph	B cell surface, blood, lymph	Bound to mast and basophil cells throughout body, blood
Molecular weight	150,000	970,000	405,000	175,000	190,000
Half-life in serum	23 days	5 days	6 days	3 days	2 days
Complement fixation	Yes	Yes	No†	No	No
Placental transfer	Yes	No	No	No	No
Known functions	Enhances phagocytosis; neutralizes toxins and viruses; protects fetus and newborn	Especially effective against microorganisms and agglutinating antigens; first antibodies produced in response to initial infection	Localized protection on mucosal surfaces	Serum function not known; presence on B cells functions in initiation of immune response	Allergic reactions; possibly lysis of parasitic worms

Highest

Lowest

Least

Fetus

Alternative

Activated complement

*Percentage in serum only; if mucous membranes and body secretions are included, percentage is much higher.
† May be yes via alternate pathway.

Functions of antibodies

Antibody dependent cell- mediated cytotoxicity

Antibodies coat infecting cell (large parasite usually) - FC facing outwards

NK (lysing ability), Macrophage,neutrophils, and eosinophils have receptors for FC region of antibody

Secretion of lytic enzymes to destroy parasite

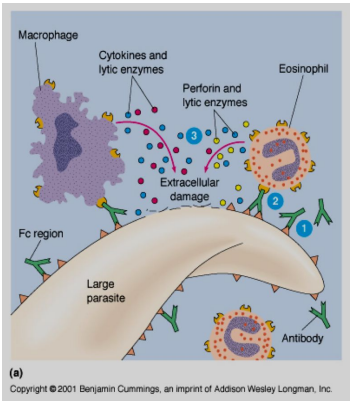
Opsonization and phagocytosis

Antibodies coat infecting cells and facilitate their phagocytosis by cells possessing Fc Receptors

FC is an antibody receptor involved in antigen recognition which is located at the membrane of certain immune cells including B cells

Complement activation

classical pathway , after binding to antigen IgM+++ , IgG1 > IgG3 > IgG2



Transplacental transfer

IgG

Its a link that transfer maternal autoantibodies from the pregnant mother to the fetus through the placenta.

Primary & Secondary immune responses

1

Primary immune response

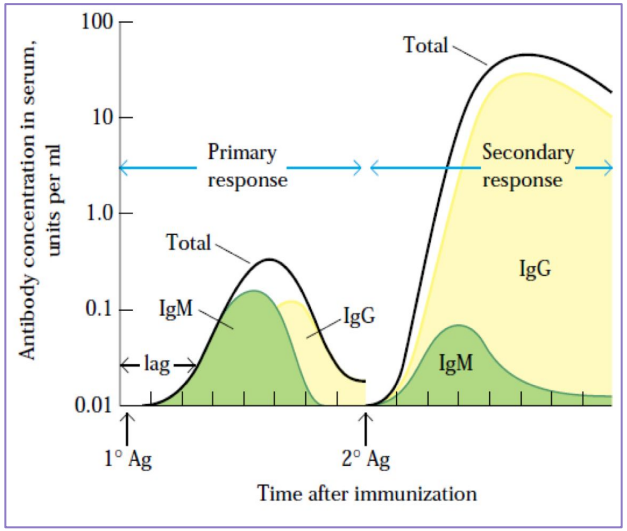
Initial encounter with antigen produce

2

Secondary immune response

Subsequent encounter with same antigen produces

Concentration & type of antibody in primary & secondary immune responses



-IgM is the main antibody involved in primary response
-IgG is the main antibody involved in the secondary immune response

438 note

This graph is an example of why we receive multiple vaccinations against diseases (Hepatitis B). It shows the efficacy differences between the initial and the second vaccinations, with the latter being much more effective.
A detailed comparison is shown in the next slide.

Comparison Between Primary & Secondary Responses (refer to previous graph)

Property	Primary response	Secondary response
Responding B cell	**Naive B cell** (virgin) -means it's a cell that never recognized an antigen before -IgD and IgM are found in its surface.	**Memory B cell**
Lag period following antigen administration	4-7 days	1-3 days
Time of peak response	7-10 days (takes time)	3-5 days (faster)
Magnitude of peak antibody Response	Varies depending on antigen	100-1000 times higher than primary
Predominant Isotype produced	**IgM**	**IgG**

Take Home Messages :

B cells can be activated by antigen to produce antibodies either with the assistance of helper T cells or directly by the antigen itself

-Antibodies are made up of two heavy and two light amino acid chains and have a shape of letter “Y”
-Different types of antibodies are located at various sites to provide protection by agglutination, precipitation, complement fixation etc.

Secondary humoral immune response is swift and a stronger immune response mediated by IgG class of antibodies because of the memory cells.

Quiz

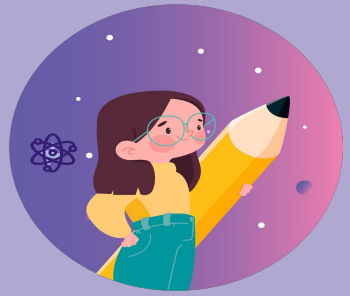
Question 1: Antigen are mainly			
A - Polysaccharides	**B**- Lipopolysaccharides	**C**- Glycoprotein	**D**- both A&B
Question 2: What type of antigen have no immunologic memory ?			
A - T-dependent antigens	**B**- T-independent antigens	**C**- both	**D**- neither
Question 3: Antigen bind to specific site on Antibodies surface called			
A - Paratope	**B**- Epitope	**C**- Tritope	**D**- Suntop
Question 4: the antibody have the shape of a letter.....			
A - X	**B**- V	**C**- Y	**D**- M
Question 5: Antibodies are immunoglobulins with specific			
A - Structure	**B**- Function	**C**- Antigen	**D**- antibiotic

1:D
2:B
3:A
4:C
5:B

team leaders

Hessah Fahad Alalyan

Faisal alotaibi



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