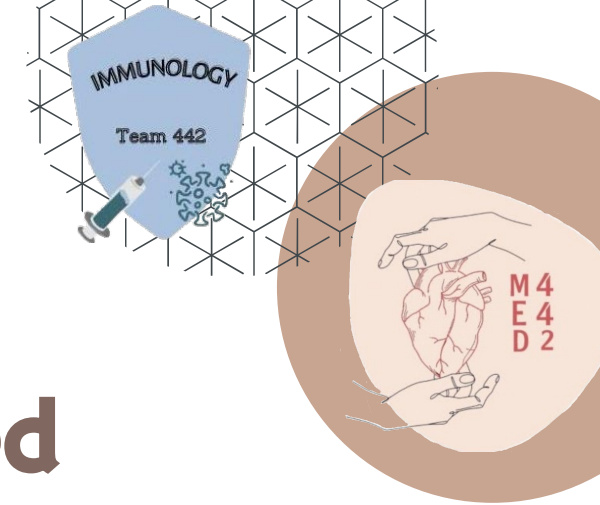
Foundation block

KSU



Antibody-mediated immunity

W6
L4

Color index :

- Main text
- Important
- Dr notes
- Females slides
- Male slides
- Extra

Editing File

Objectives

- To describe B-cells as the mediators of humoral immunity (antibody-mediated immunity)
- To describe activation of B-cells which involve: Antigen recognition,T-dependent ,T-independent antigens ,Requirement for T-helper cells
- To explain clonal selection, clonal expansion & generation of plasma cells & memory cells
- To describe primary & secondary immune responses
- To describe the structure & function of Immunoglobulins

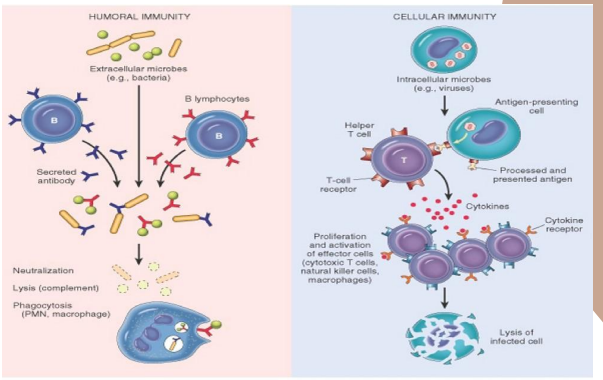
Helpful video

Types of immunity

- Adaptive(Acquired) immunity
  - Cell Mediated Immunity (CMI)
  - Humoral immunity (AbMI)
- Innate (Natural) Immunity

The Humoral Immune Response is the aspect of immunity that is mediated by secreted antibodies.
The response takes place in body fluids/humor such as blood and lymph

Extracellular | Intracellular



Activation of B cells by antigens

T-dependent antigens

- Antibody production by B-cells requires T-helper cells
- Antigen presenting cells (APC) recognizes the Antigen & presents it to T-helper cells
- T-helper cells stimulate B-cells specific for that Antigen to become plasma cells
- T-dependant Antigens are mainly proteins on viruses, bacteria & other foreign materials

T-independent antigens

- B-cells DO NOT require T-helper cells to produce antibody
- Antigens 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

Activation of B cells (T-dependent)

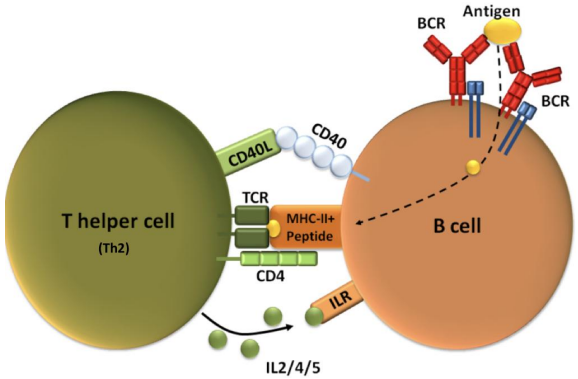
➢ Th1 is a CD4 cell which promotes Cell Mediated Immunity (previous lecture)

➢ Th2 is a CD4 cell which promotes Antibody mediated immunity (this lecture)

➢ Cell activation leads to:

○proliferation تكاثر/انتشار

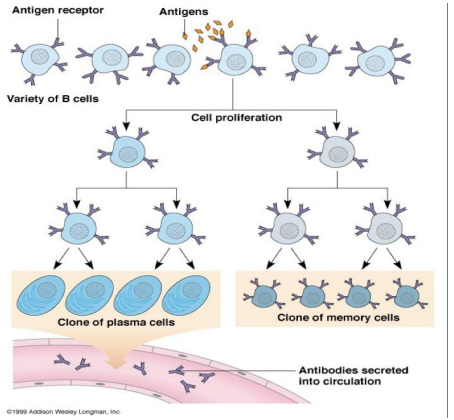
○ Release of cytokines (lecture 2)



Clonal selection and clonal proliferation

Team 439:

B-cells are activated by the binding of an Antigen to a **specific receptor** on its surface, which **stimulates** the cell to divide and proliferate (multiply very fast) In the end it produces plasma cells and memory cells

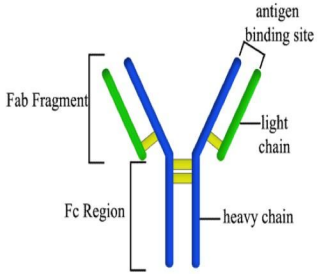


igG is the only one who can trans from the mother to her baby

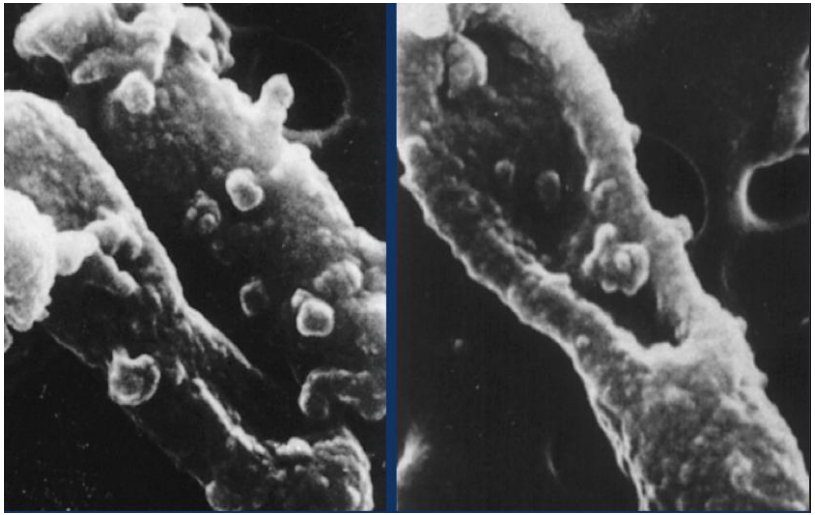
Antibodies

Features and structure

- Variable region has the potential to bind with particular classes of antigens
- Antibodies bind to specific sites on antigen surfaces called (**epitopes**)and perform protective functions by different mechanisms
- 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
- Antibodies are immunoglobulins (Ig) with specific functions
- Can fit as precisely as a lock-and-key to an antigen
- Have the shape of a letter "Y"
- Made up of four polypeptides chains
- Two longer and larger (heavy chains) and the other two shorter and smaller (light chains)



Electron micrographs of the effect of antibodies and complement upon bacteria



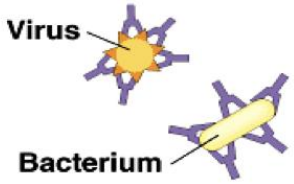
Antibody + complement-mediated damage to E. coli

Healthy E. coli

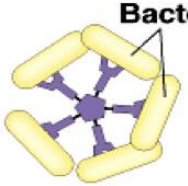
Protective functions of antibodies

Binding of antibodies to antigens inactivate antigen by

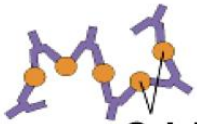
Neutralization (blocks viral binding sites; coats bacteria and/or opsonization)



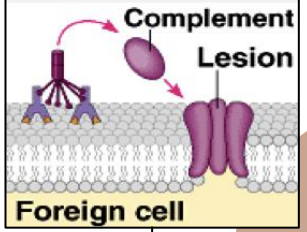
Agglutination of antigen-bearing particles, such as microbes



Precipitation of soluble antigens

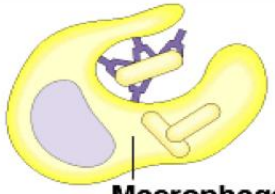


Complement fixation (activation of complement)



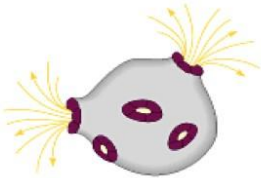
Enhances

Phagocytosis



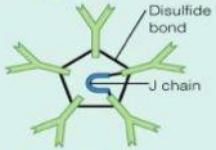
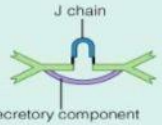
Leads to

Cell lysis



Immunoglobulin Classes

Contain doctor's notes

Characteristics	IgG	IgM	IgA	IgD	IgE
	All monomer exept ?				
Structure	Monomer	Pentamer خماسي	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) هو خماسي بس بعبره في الدم	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 (longest Half-life)	5 days	6 days	3 days	2 days (lowest Half-life)
Complement fixation	Yes	Yes	No†	No	No
Placental transfer	Yes (the only one)	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

*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 :

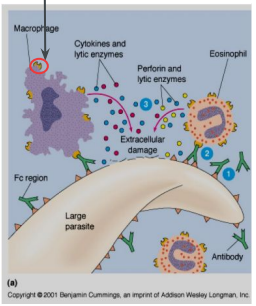
Antibody dependent cell– mediated cytotoxicity

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

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

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

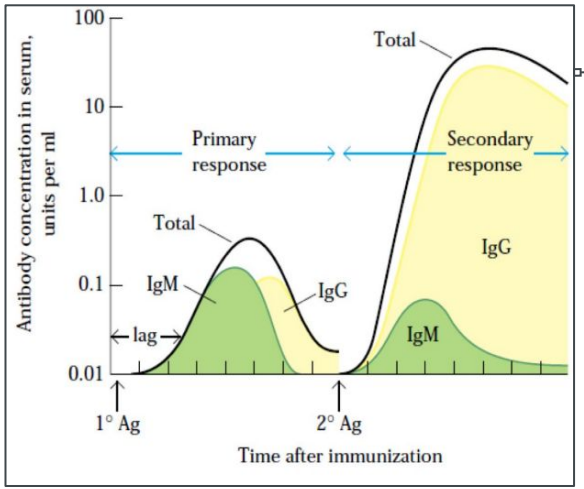
Primary immune response:
produced by initial encounter with antigen

The main antibody involved is IgM

2

Secondary immune response:
produced by subsequent challenge with same antigen

The main antibody involved is IgG



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.

Comparison between Primary & Secondary responses

Property	Primary response	Secondary response
Responding B cell	Naive B cell (virgin) (no memory)	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 :

1. B cells can be activated by antigen to produce antibodies either with the assistance of helper T cells or directly by the antigen itself.
2. Antibodies are made up of two heavy and two light amino acid chains and have a shape of letter “Y”.
3. Different types of antibodies are located at various sites to provide protection by agglutination, precipitation, complement fixation etc.
4. Secondary humoral immune response is swift and a stronger immune response mediated by IgG class of antibodies because of the memory cells.

MCQ

Q1- Antibody structure is made of …….. polypeptide chains:			
A) Three	B) Seven	C) Two	D) Four
Q2- Transplacental transfer…..			
A) IgA	B) IgG	C) IgE	D) none
Q3- Antibody have the shape of ……			
A) Y letter	B) V letter	C) L letter	D) X letter
Q4- Antigens are mainly polysaccharides or ..... with repeating subunits (bacterial capsules).			
A) lipopolysaccharides	B) glycoproteins	C) lipoprotein	D) Peptidoglycan

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

MCQ

Q5- The responding B cells in the Secondary immune response :			
A) Virgin B cell	**B) Mature T cell**	**C) Memory B cell**	**D) none**
Q6- Antibodies are immunoglobulins with specific …….			
A) Structure	**B) Function**	**C) Antigen**	**D) Antibiotic**
Q7- Antigen bind to specific site on Antibodies surface called …… .			
A) Paratope	**B)Epitope**	**C) Tritope**	**D) none**
Q8- The main antibody involved in the primary immune response is :			
A) IgM	**B) IgE**	**C) IgA**	**D) IgG**

5:C
6:B
7:A
8:A

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★ Special thanks to Immunology Team (441).

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