Grade 12 LS- Immunology (Chapters 6 and 7)

This document includes questions that aim to summarize most of the points in the immunology course and assure attaining all the needed acquired knowledge for the official exam.

1) **List the signs of inflammatory reaction.**

   Redness, heat, pain and edema (swelling)

2) **Upon infection, damaged cells secrete certain chemicals that have local and systematic effects**

   a. **Name these chemicals**

      cytokines

   b. **Indicate the function of these cytokines and how they lead to the signs of inflammation**

      Cytokines induce vasodilation leading to increase of blood flow which is the reason of redness and heat. In addition, other cytokines increase vascular permeability so plasma diffuse toward infected tissue in addition to some cells that are attracted by chemokines by process called chemotaxis. The flow of plasma and cells to infected area leads to swelling.

      Note: Feeling of pain is due to of some chemicals (prostaglandin) that stimulate pain receptor in the area.

3) **Name the mechanism by which certain leukocytes are attracted to infected area**.

   Chemotaxis

4) **Name the process by which monocytes leave blood vessel into infected tissue.**

   Diapedesis

5) **Explain how macrophage reach infected tissue**

   Upon infection, the infected cells, the macrophage and other leukocytes release cytokines having local and systematic effects inducing vasodilation of blood capillary in the area, which increase the blood flow. In addition, some cytokines have chemotactic effect, which attract monocytes to the site of infection by chemotaxis. The monocytes then cross the blood vessel by diapedesis where they transform into macrophage.

6) **List the phases of phagocytosis**

   Adhesion, absorption, digestion

7) **What is the type of MHC where peptide of the phagocytosed antigen is presented?** MHC II

8) **Why phagocytosis is considered as non- specific immune response?**

   Because the macrophages phagocytes any intruder regardless of its identity (phagocytes done have specific receptors for specific antigens)

9) **What are the characteristics of non-specific immune response?**

   No latency period, non-specific

10) **There are 2 types of specific immune response**

    a. **Name them**

Cell mediated immune response and Humoral mediated immune response.

b. **Indicate the effector cell / molecule of each of them.**

Cell mediated immune response: cytotoxic Tc

Humoral mediated immune response: Plasma cell / Antibodies

11) **After phagocytosis and presentation of peptide on the specific MHC, macrophage is now called**..? APC: Antigen Presenting Cell

12) **Indicate the site of induction of immunity against antigens if the antigen is circulating through blood or though lymphatic tissues (tissue was infected)**

If the antigen was through blood, spleen.

If the antigen was circulating through lymphatic tissue, lymph nodes.

13) **APC migrates to the nearest lymph node Or spleen**

a. **Indicate the function of lymph node**

Site of interaction between leukocytes and antigens coming through lymph

b. **Name the cell that the APC activates in lymph node.** T4

c. **Explain the mechanism of activation/ Or Explain macrophage role in induction of specific immune response.**

The macrophage phagocytes the non-self-antigen, it associates its peptides to HLA-II on its membrane surface. Macrophage migrates to the closest lymph node where it becomes APC (Antigen Presenting Cell) When antigen specific T4 arrives, it binds on the HLA-II non-self-peptide complex by double recognition with its TCR leading to its activation. This is the "clonal selection"

d. **Explain the necessity of the seven days time delay for the lymphocytes proliferation. (2008 1st)**

"7 days time delay" is necessary to induce the immune response. Macrophages phagocyte the antigens and become APC that migrate towards the lymphatic ganglia. APC bind to the lymphocytes via their specific receptors and activate them.

14) **Non-specific immune response triggers specific immune response. Explain this statement.**

The macrophages are the effector cells of the non-specific immune response while lymphocytes are the effectors of the specific immune response, and without macrophage, the lymphocytes can not produce antibodies.

15) **Activated T4 cells secreted certain type of cytokines**

a. **Name these molecules Interleukins:** (IL-2 and IL-4)

b. **Indicate their function:** IL-2 activates Tc that has the specific TCR for the non-self peptide and already bound to MHC-I non self-peptide-complex on infected cell by double recognition through its TCR. IL-4 activates B cells having the antibody specific to the antigen and that are already bound to it.

c. Explain mechanism by which these molecules activate their target cells (activation of B or T lymphocytes).

IL-2 secreted by T4 cells activates only T8 that has the specific TCR and already bound to the peptide MHC-1 complex by double recognition. This is clonal selection. This leads to multiplication of the activated T8 obtaining slightly differentiated memory cells and differentiation leading to having cytotoxic Tc.

IL-4 secreted by T4 cells activates only BL that has the specific immunoglobulin to the antigen and already bound to it. This is clonal selection. This leads to multiplication of the activated B cells obtaining slightly differentiated memory cells and differentiation leading to having plasma cells.

16) Explain how Plasma cells (plasmocytes) are cells adapted for secretion of antibodies. (2017 1st)

Plasma cells have a well-developed cytoplasm rich in rough endoplasmic reticulum involved in protein synthesis and since antibodies are proteins, therefore the plasma cell is a cell adapted to the secretion of antibodies

17) Explain the mechanism of antibodies against toxins leading to their neutralization

Toxins attach the target cells by binding to membrane receptors. When the antibodies bind to the toxins they cover their attachment sites on the target cells and prevent the toxin from acting. This is neutralization.

18) Explain the 2 ways how antibodies may eliminate the antigen.

By opsonization: After binding of the antibodies using their Ag binding sites of variable region to the epitope of the antigen, the antibody can bind to membrane receptors of macrophage through its constant region making a molecular bridge between antigen and the phagocyte that facilitates adhesion. This is opsonization. The macrophage phagocytes the antibody with antigen bound to it in order to eliminate them.

Activation of complement: Upon the binding of antibodies by their variable region on the bacterial antigens, a complement protein C1, may bind to constant region and become activated. This activation leads to complement cascade activation from C1 to C9 that forms at the end a membrane attack complex (MAC) on surface of the bacteria that perforate the membrane of this cell destroying it.

19) Explain the role of antibodies in defense against viral infection.

Viruses enter their target cell through the binding of their surface molecules to a specific receptor expressed by the membrane of the target cell. By binding to these surface molecules. The antibodies can prevent the entry of the virus into the host cell and thus neutralize its activity.

20) Specific immune response facilitates the function of non- specific immune response. Explain this statement.

Upon binding of antibodies to their specific antigen (that is a specific immune response). The antibody can bind to membrane receptor of macrophage through its constant region facilitating adhesion of phagocyte and

perform phagocytosis that is non-specific. So specific immune response facilitate the function of nonspecific immune response.

21) **Indicate the roles and the moments where macrophages intervene in the specific immune response (2015 1st).**

At the beginning of the specific immune response, macrophages act as antigen presenting cells which induce the specific immune response. At the end of the specific humoral immune response, they perform phagocytosis of the immune complex in order to eliminate antigens

22) **Upon antigen infection, immune complexes appear after certain time but then disappear. Explain (2008 1st)**

The appearance of immune complexes is due to the neutralization of the antigen by the antibodies secreted by plasmocytes. The disappearance of these complexes is due to the opsonisation and phagocytosis carried out by macrophages.

23) **Explain how secreted antibodies contribute to the destruction of a virus. (refer to 2011 1st)**

The specific antibodies neutralize their corresponding antigens of the flu virus by binding to them through their specific antigenic binding sites forming immune complexes. Thus the antibodies become able to bind through their constant part on macrophages that phagocyte the whole immune complexes thus destroying the virus (opsonization).

24) **Indicate the type of foreign antigens that triggers cell-mediated specific immune response, and give an example.**

Intracellular antigens such as viruses.

25) **Justify the necessity of cell mediated immune response to eliminate virus from the body.**

Viruses are intracellular pathogens can only multiply within the host cell, elimination of the virus from the body requires destruction of cells infected by the virus which is performed by Tc lymphocytes, effectors of the specific cell mediated immune response

26) **Explain why nude mouse (lack thymus) lacks humoral and cell mediated immune response**

In the absence of thymus, TL cannot be mature so there is absence of TC leading to no cell-mediated specific immune response. Moreover, there is no mature T4 which cannot be activated to secrete interleukin 4 so cannot activate B-lymphocytes. Therefore, humoral mediated immune response will not be activated

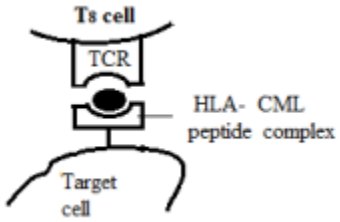
27) **Compare between memory cells and effector cells (differentiated) regarding ability of proliferation and life span**

Memory cells have long life span and can proliferate while differentiated cells can not proliferate and have short life span.

28) **Explain how the anti-CD4 antibodies intervene in accepting grafts. (2008 2nd)**

They fix to TL4 receptors to block them. The blocked TL4 are not activated and do not proliferate nor do they differentiate into cells that secrete interleukins 2. Thus, the TL8 are not activated and the graft is successful. Anti-CD4 antibodies can be used as immunosuppressor drugs during grafting.

29) **Draw a scheme showing the molecules involved in the recognition taking place between the activated T8 cell and the target cell**.



Title: Scheme of the recognition site between T8 cells and the target cell

30) **Indicate the conditions necessary for T4 proliferation (refer to 2017 2nd) + additional information**.

T4 recognize the non-self-peptide MHC II complex by double recognition (note: same as for T8 cells by the way) for that: cooperation between T4 and macrophage is necessary for T4 proliferation T4 and macrophage must be from the same strain. (2017 2nd) T4 must have the TCR specific for non-self-peptide MHC II complex presented on macrophage.

31) **Specify the consequence of the absence of the macrophages on the specific immune responses. (2017 2nd)** T

he induction of specific immune response ceases because the activation of T4 lymphocytes necessitate its binding to APC. So in the absence of activated T4 lymphocytes, no more secretion of interleukin 2 takes place which is responsible for launching the specific cell mediated immune response. Moreover, no interleukin 4 secretion takes place which is responsible for launching of the specific humoral immune response.

32) **Explain the mechanism that leads to the destruction of target cells (infected cells) by Tc lymphocytes (2010 2nd)**

The Tc lymphocytes recognize and bind, by its TCR, to target cells expressing the modified self: self MHC I carrying a non-self-peptide of the antigen that is at the origin of their activation. They will then release, by exocytosis, perforin molecules forming hollow polyperforin channels through the cell membrane, and then they release granzymes molecules that penetrate the target cell through these channels leading to DNA degradation and to the target cell destruction.

33) **Explain how the cells: macrophage, T4 and T8 intervene in cell lysis (2007 1st)**

The macrophages digest the free virus, recognized as non-self, and transform them into peptides and present them on HLA molecules of class II. These macrophages are thus, antigen presenting cells (APC). These latter migrate towards the lymphatic ganglia where they activate the LT4 that has TCR specific for the peptide

expressed on APC that secrete IL-2. IL-2 activates the specific LT8 (LTc), which adheres to the membrane of the target cell and binds to MHC-I non self peptide complex by its TCR by double recognition and releases perforin that forms polyperforin channel and granzymes that enters through polyperforin channel and degrades the DNA leading to cell lysis.

34) **Indicate the characteristics of secondary immune response:** More amplified, faster, long lasting.

35) **Note: To prove the following characteristics:**

More amplified: compare the number of antibodies produced or number of specific T8 cells between 1st contact and second contact.

Faster: Compare the time needed to trigger the immune response (when the antibodies increase or T8 cells)

Long lasting: Compare the final amount shown in graph where upon 2ary contact the amount of antibodies would be much higher than 1st contact which reaches 0 after certain time

36) **Explain the origin of characteristics of the 2ary immune response/ or the results in experiments shows the elimination of antigen upon second contact is faster (in less time) explain the results.**

During the secondary immune response there are memory cells that are more numerous and more differentiated than naïve cells (B or T cells depending on your exercise) sensitized during the primary immune response. These memory cells are able to recognize the antigen faster, proliferate, and differentiate to a larger number of plasma cells that secrete higher concentration of antibodies persist for a longer time (or activated T8 depending on the exercise)

37) **Indicate how does vaccine protect against antigen? (2013 2nd)**

Vaccines immunize the organism against a specific antigen by inducing a durable immunological memory.

38) **Explain the importance of vaccine (2016 1st)**

Vaccine ensures the first contact with this antigen and triggers immunological memory. Consequently, the body, after a second contact, develops a secondary response which is more amplified, more rapid and more durable against this antigen

39) **Given that infection with a certain virus causes cervical cancer. Explain how vaccination against this virus protects against cervical cancer. (2015 2nd)**

The antibodies produced due to vaccination neutralize the viruses before they bind to the membrane receptors of the target cells of the cervix and inhibit the viruses from infecting them. The viruses are thus eliminated (the formed immune complexes will be phagocyted by macrophages).

40) Distinguish between vaccination and serotherapy (2015 1st). Refer to this table for information but write your answer as text by comparing each criteria.

	Vaccination	Serotherapy
Nature of the injection	Killed or attenuated antigen	Serum contacting antibodies
Origin of antibodies	Endogenous	Exogenous
Latency period	2 weeks	null
Duration of protection	Several years (**more durable**)	Two weeks **(short)**
Nature of immunity acquired	Active	Passive

41) You might be asked to specify the importance of a certain step of experimental protocol.

Usually, this step is necessary to *assure presence of only one variable* in order to reach a proper conclusion.

Strategy of thinking: Ask yourself what would happen if this step wasn't included or different?

- **Examples as following:**
  - **Example 1**: Refer to 2012 2nd:

    In the framework of determining the conditions of the production of antibodies during the immune response, we perform a series of experiments on mice of the same strain. Experiment Mice are subjected to the ablation of the thymus followed by irradiation that destroys all cells of the immune system. These mice are then divided into 4 lots and treated as shown in document 1. (injection with different types of lymphocytes)

    a. Specify the aim of destroying the cells of the immune system before starting the experiment.

    This will ensure that the immune response triggered by the mice is due only to the injected cells and not due to cells presented already in the body.

    b. Specify why the injected lymphocytes should be from the same strain.

    T lymphocytes by their TCR recognize peptides within MHC complex by double recognition (recognize the non self peptide and recognize the MHC complex.) So, if the T lymphocytes where from other strain they would have different MHC which can't be recognized by T lymphocytes.

  - **Example 2:**

    To study the immune response against tumors, several experiments were done started by graft of tumor to a mouse from the same strain (same MHC).

    Explain why the tumor transplant should be from mouse having same MHC (or same strain)

    If the tumor is of different MHC, it can be rejected due to the different MHC marker but not because of its tumor character. On the other hand, a grafted tumor from a different MHC mouse presents for the experiment two variable factors that do not allow us to draw the conclusion proper the problem.

42) A diabetic rat is treated with cyclosporine (immunosuppressive substance), it becomes healthy. Explain

This means that the disease is due to the immunity since once attenuated the disease is cured. Therefore, the diabetes of this rat is due to an autoimmune disease.

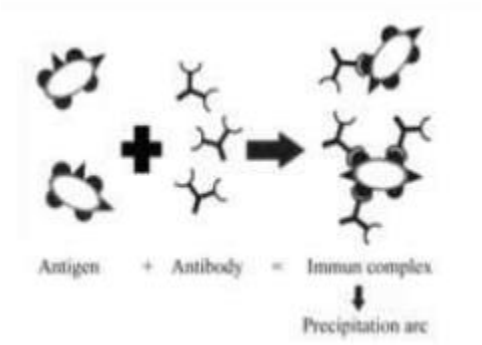
43) An arthritic rat, is subjected to thymus ablation, after a while it becomes healthy. Explain

This result means that the disease is due to the thymus (immunity), because without thymus there is no mature T lymphocytes and the disease disappears. Therefore, the disease is an autoimmune disease.

44) Injection of antibodies of affected individual into a normal one leads to same disease (same symptoms) that disappear after a while. Explain

This result means that the disease is due to the antibodies which transmitted the disease to the other individual and the disease disappeared after the amount of injected of antibodies decline. Therefore the disease is due to an autoimmune disease.

45) Schematize a diagram showing the mechanism that leads to the formation of the precipitation arc in immunodiffusion in gel (immune complex). (2010 1st)



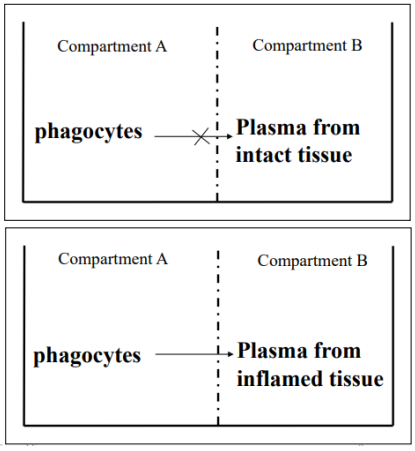
46) Name the technique used for detection of HIV virus: ELISA

47) Name the technique used for detection of specific protein, receptor..? Immunofluorescence

48) Application:

An apparatus is made up of 2 compartments separated by a porous filter (filter containing pores). The first compartment (A) contains phagocytes and the other (B) contains plasma either from normal or from an inflamed tissue. Results show movement of phagocytes from their compartment toward inflamed tissue plasma.

a. Interpret the experiment.
b. What can you conclude regarding inflamed cells?
c. Explain how macrophages reach the infected tissue.



a. Separating by a porous filter phagocytes and plasma from an inflamed tissue leads to the movement of phagocytes and plasma from an inflamed tissue leads to the movement of phagocytes toward the compartment that contains the plasma. **On the contrary,** where phagocytes didn't move toward plasma from intact tissue.
This signifies/indicates/means that the plasma of infected tissue contains substances that have the ability to attract the phagocytes.

b. We conclude that inflamed cells secrete chemotactic substances.

C. Upon infection, the infected cells, the macrophage and other leukocytes release cytokines having local and systematic effects inducing vasodilation of blood capillary in the area, which increase the blood flow. In addition, some cytokines have chemotactic effect, which attract monocytes to the site of infection by chemotaxis. The monocytes then cross the blood vessel by diapedesis where they transform into macrophage

Sources: Official Exams, Biocatalyst, booklet for T. Rola Dirani, T.Abed Al Kareem Noureddine

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