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Biology

ENGLISH MEDIUM

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B.Sc. (Hons), M.Sc.

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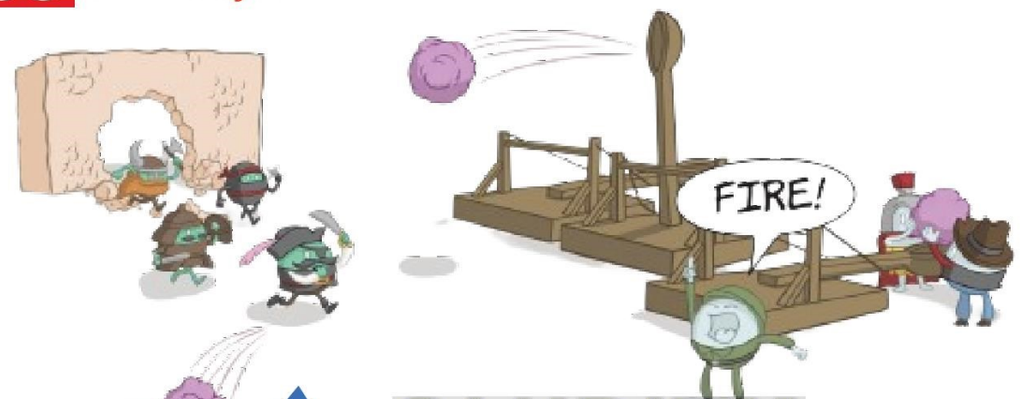
UNIT 05

Animal Form and Function

Immune System



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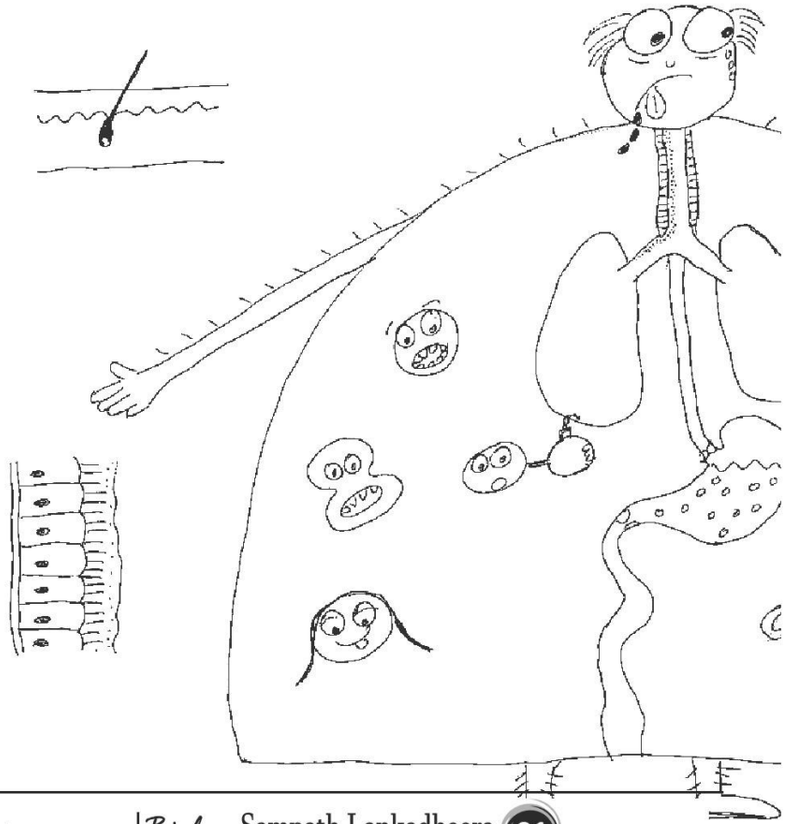


3. Explain briefly how the human body defends specifically against pathogenic microorganisms.

1. lymphocytes
2. and B lymphocytes
3. are the cells that have the ability to carry out acquired immune responses
4. against antigens.
5. Antigens are usually large foreign molecules such as proteins and polysaccharides.
6. Certain parts of a large antigen molecule act as epitope.
7. Two types of immune responses are mediated by T lymphocytes and B lymphocytes.
8. They are Cell mediated immune responses
9. and Humoral immune responses.
10. In cell mediated immune response specifically sensitized T lymphocytes
11. attached to the antigen undergo proliferation and eventually differentiate into “Cytotoxic T cells”
12. that can directly kill the cells with the invading antigen.
13. In addition “Memory T cells” are formed.
14. that can cause stronger and more rapid response at the subsequent encounter of the same antigen to the body.
15. Cell mediated immunity always involves cells attacking cells.
16. In humoral immune response specifically sensitized B lymphocytes undergo proliferation
17. and differentiate into “Plasma cells”
18. that secrete antibodies that can neutralize
19. and inactivate the specific toxins
20. and pathogens in the blood
21. and lymph.
22. In addition “Memory B cells” are formed
23. that can cause stronger and more rapid response at subsequent encounter of the same antigen.
24. Humoral immune response works against antigens present in body fluids and extracellular pathogens.
25. This immunological memory is called secondary immune responses.
26. Naturally acquired active immunity is a long lasting immunity developed in the body
27. against various infectious diseases in response to natural infections of pathogens.
28. In response to a disease causing agent entering the body naturally for the first time (e.g. Virus of Chicken-pox),

Answer

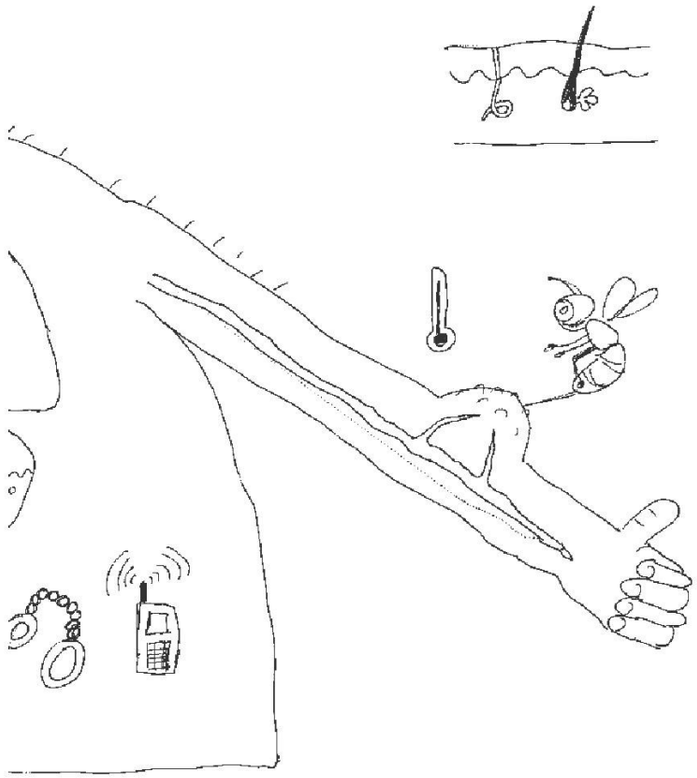
1. Explain briefly how the human Barrier defense act against pathogenic microorganisms.

1. Barrier defense consist. Human **skin** with its many layers of closely packed,
2. keratinized cell layers in the epidermis
3. provides a significant physical barrier to entrance of microbes.
4. In addition periodic shedding of epidermal cells helps remove microbes from the skin surface.
5. The **mucous membranes** which line the body cavities
6. provide a physical barrier to entrance of many microbes
7. The mucous membranes produce mucus which traps microbes and other particles.
8. In the respiratory tract, ciliated epithelial cells sweep mucus and any entrapped material upward.
9. Coughing and sneezing speed up the mucus movement and its entrapped pathogens out of the body preventing their entry to the lungs.
10. **Secretions** by various organs (Eg. tears, saliva, mucus)
11. help as physical
12. and chemical barriers to protect epithelial surface of the skin and mucous membranes.
13. Tears in the eyes provide protection against irritants and microbes.
14. Tears in the eyes provide continuous washing action that helps to dilute microbes
15. and prevent settling on the surface of eyes.
16. Saliva washes microbes from the mouth surface
17. and the flow of saliva reduces the colonization of microbes in the mouth.
18. Mucus secretions which bathe various exposed epithelia provide a continual washing action
19. to dilute and inhibit colonization microbes such as bacteria and fungi.
20. Lysozyme (an enzyme) present in tears,
21. saliva, perspiration and mucous secretions
22. can destroy cell walls of some bacteria.
23. Gastric juice which provides an acidic environment in the stomach
24. can destroy many bacteria and bacterial toxins ingested with food.
25. Secretions of the sweat and sebaceous glands of the skin give acidity of the skin
26. which helps to prevent growth of bacteria.

2. Explain briefly how the human internal non-specific defense act against pathogenic micro-organisms.

1. Internal defenses consist of , **Phagocytic cells:**
2. These are specialized cells that can ingest microbes,
3. foreign particles and cell debris for intra cellular digestion and destruction.
4. Phagocytes use the receptor molecules to detect components of foreign agents and particles.
5. Neutrophils and Macrophages are the two main types of phagocytic cells in man.
6. **Natural killer cells:**
7. are a type of lymphocytes present
8. They can detect the cells with abnormal surface molecules
9. and kill them.
10. Natural killer cells can release chemicals to kill the virus-infected cells
11. and cancerous cells which could inhibit further spread of the virus or cancer.
12. Antimicrobial proteins:
13. are proteins present in the blood
14. and interstitial fluids
15. which function in innate.
16. **Interferons** are proteins
17. secreted by virus-infected body cells that protect uninfected host cells from viral infections.
18. neighboring cells are stimulated to produce “antiviral proteins” which inhibit viral replication.
19. Some interferons activate macrophages which enhance the phagocytic activity.
20. Complement proteins are a group of normally inactive proteins in the blood plasma and plasma membranes.
21. When they are activated by different substances present on the surfaces of microbes
22. They also promote phagocytosis
23. and inflammatory response.
24. Inflammatory response:
25. is an innate immune defense response in the body
26. to tissue damage triggered by microbial infections or injury of the tissues.
27. This involves the release of substances that promote increased permeability
28. and dilation of blood vessels,
29. enhance migration of phagocytes,
30. destruction of invading pathogens and aid in tissue repair.
31. Histamine is one of the important inflammatory signaling molecules
32. released mainly by mast cells in the connective tissues at the site of damage.
33. Histamine causes increased permeability and dilation of nearby blood vessels (blood capillaries).
34. Dilation of blood vessels causes redness
35. and heat production due to high metabolism in the area.
36. Increased permeability of blood vessels triggers localized swelling due to leaking of tissue fluid into neighboring tissues.
37. Pain results from injury to neurons and microbial toxins.
38. As a result of most inflammatory responses, pus may be accumulated.
39. Elevated body temperature within limits may enhance the phagocytosis and accelerate tissue repair by speeding up the chemical reactions.

Any 50 x 3 = 150 Marks



5.4.1 : Explores types of Immunity

Immunity

…….

…….

……. Pathogens which are the agents that can cause infectious diseases include some ……., ……. and ……. The substances that can be recognized as foreign to the body include …… components of …… grains, incompatible blood cells and …….. tissues. Defenses in the animal body against these foreign invasions make up the immune system. Immune system of animals should be able to distinguish …… body cells (self) from …… cells/particles within the body (non-self) for initiating defensive immune responses for destruction of the foreign agents such as pathogens. Special cell types in the body fluid and tissues of most animals can interact with these foreign invasions and destroy them. Immune cells produce receptor molecules that bind specifically to molecules from foreign cells and agents and activate defense responses.

Immune responses in animals can be divided into two types:

- ……...
- ……...

Innate Immunity

…….

…….

…….

In innate immunity recognition and defense responses will depend on characters common to …… of pathogens. Innate immunity lacks specific responses to specific invaders and its protective mechanisms functions the same way regardless of the type of the invader. Hence innate immunity is also known as ……

Innate immune responses include defense mechanisms that provide immediate but general protection against foreign invasion. Innate immunity is found in both …… and ……. Innate defense mechanisms can be broadly divided into two types: ……(External defenses/barrier defense) and …… …… (Internal defenses).

Essay Aid

1. Explain briefly how the human barrier defends act against pathogenic microorganisms.
2. Explain briefly how the human internal nonspecific defense act against pathogenic microorganisms.
3. Explain briefly how the human body defends specifically against pathogenic microorganisms.

26. Proteins secreted by plasma cells in response to specific antigens that bind with antigens to neutralize, inhibit or destroy them
27. T lymphocytes
28. Macrophages, dendritic cells and B cells
29. They undergo multiple cell divisions (proliferation) resulting in clones, some become effector cells for immediate response
30. Cytotoxic T cells and Helper T cells
31. Plasma cells
32. Memory cells are long-lived cells that can give rise to effector cells if same antigen is encountered later, providing faster and stronger responses
33. (a) Active immunity: Immune response developed by body's own cells
    Passive immunity: Transfer of antibodies from another individual for temporary protection
    (b) Natural: Occurs through natural infection/maternal transfer
    Artificial: Occurs through vaccination or manufactured antibody injection
    (c) Through placental transfer during pregnancy and through breast milk (colostrum)
    (d) Recovery from chickenpox infection
    (e) Through vaccination with tetanus toxoid
    (f) Provides immediate protection through ready-made antibodies when infectious agents accidentally enter body
34. Exaggerated responses of body to certain antigens (allergens) that are tolerated by most other people
35. Pollens, dust, some food (Cuttlefish, Prawns), antibiotics (penicillin), venom from honey bees and wasps
36. Sneezing, runny nose, teary eyes, smooth muscle contractions in airways, breathing difficulties
37. Immune system becomes active against particular self-molecules of body and attacks person's own tissues
38. Genetic factors, gender, and unknown environmental triggers
39. Many autoimmune diseases affect females more than males due to genetic factors
40. Production of autoantibodies and activation of Cytotoxic T cells that destroy certain body cells
41. Type 1 Diabetes mellitus, Multiple sclerosis, Rheumatoid arthritis
42. Disorder in which responses of immune system to antigens are defective or absent
43. Inborn immunodeficiency and Acquired immunodeficiency
44. Exposure to chemicals or biological agents
45. Drugs used to fight autoimmune diseases or prevent transplant rejections
46. Resistance against chickenpox: Naturally acquired active immunity
    Mother's antibodies protection: Naturally acquired passive immunity
    Polio oral vaccines: Artificially acquired active immunity
    Anti-rabies injection: Artificially acquired passive immunity
    Anti-rabies vaccine: Artificially acquired active immunity
    Tetanus toxoid: Artificially acquired active immunity
    Antitetanus vaccine: Artificially acquired passive immunity

2019 AL

Long lasting (protection)	Short term (protection)
Involve T and B lymphocytes/ T and B cells	no involvement of T and B lymphocytes/ T and B cells
Memory cells develop/immunologic memory retained	memory cells not developed/no immunologic memory
Antibodies produced in the body	Antibodies gained from outside/ Readymade antibodies

Any 3 pts

2020 AL

Proteins secreted by virus infected body cells, that can protect uninfected body cells (from viral infection) by stimulating production of anti-viral proteins /by producing proteins that inhibit viral replication.

External defenses/ barrier defense in innate immunity

External barriers discourage pathogens and foreign substances from penetrating the body. So they are considered as the …… …… ..……. For innate immunity in the human body, external defenses/barriers are found in the skin. mucus membranes and secretions of various organs. They act as physical and chemical barriers.

- Human **skin** with its many layers of …… ……, …… cell layers in the epidermis provides a significant physical barrier to entrance of microbes. In addition periodic …… of epidermal cells helps remove microbes from the skin surface.
- The **mucous membranes** which line the body cavities provide a …… barrier to entrance of many microbes (e.g. the linings of the respiratory tract. Digestive tract, urinary tract and reproductive tract). The mucous membranes produce mucus which traps microbes and other particles. In the respiratory tract, ciliated epithelial cells …… mucus and any entrapped material upward. …… and …… speed up the mucus movement and its entrapped pathogens out of the body preventing their entry to the lungs.
- **Secretions** by various organs (e.g. tears, saliva, mucus) help as physical and chemical barriers to protect epithelial surface of the skin and mucous membranes. Tears in the eyes provide protection against irritants and microbes. …… in the eyes provide continuous …… action that helps to …… microbes and prevent settling on the surface of eyes. …… washes microbes from the mouth surface and the flow of saliva …… the …… of microbes in the mouth. Mucus secretions which …… various exposed epithelia provide a continual washing action to dilute and inhibit colonization microbes such as bacteria and fungi. …… (an enzyme) present in tears, saliva, perspiration and mucous secretions can destroy cell walls of some bacteria. Gastric juice which provides an …… environment in the stomach can destroy many bacteria and bacterial toxins ingested with food. Secretions of the sweat and sebaceous glands of the skin give acidity of the skin which helps to prevent growth of bacteria.

Internal defenses in Innate immunity

When the pathogens penetrate the external defensive barriers in the skin and mucus membranes in the human body, they encounter a …… …… of innate immunity responses called internal defenses. Within the body, detection of non-self is

accomplished by molecular recognition in which …… molecules on specific cells in the immune system will bind specifically to molecules of foreign agents such as pathogens. In innate immunity. internal defenses consist of ……, ……..…… …… and ……..…… responses.

Phagocytic cells:

- These are specialized cells that can …… microbes, foreign particles and cell …… for intra cellular …… and …….
- Phagocytes use the receptor molecules to detect components of foreign agents and particles. ……...…… and ……..…… are the two main types of phagocytes cells in man.
- While circulating in the blood, …… are attracted …… to the infected site by signals from affected tissues. Then neutrophils can ingest and destroy infected pathogens.
- Macrophages are larger and more …… phagocytic cells.

Natural killer cells:

- These are a type of ……... present in the blood and some ……../……... such as …….. and ……. ……. which function in …….. defense.
- They can detect the cells with ……... …….. molecules (cg. virus- infected body cells and some cancerous cells) and kill them.
- Natural killer cells …….. engulf these abnormal cells but upon binding they can ……. chemicals to kill the ……... cells and …… cells which could inhibit further spread of the virus or cancer.

Antimicrobial proteins:

- They are proteins present in the blood and ……. fluids which function in innate defense by ……..…... microbes ……..……... or impeding their …….. lnterferons and Complement proteins are two such antimicrobial proteins that discourage microbial growth.
  ……
  ……
  ……..
  Once released by virus-infected cells, interferons diffuse to uninfected neighboring cells where they are stimulated to produce "anti-viral proteins" which inhibit viral repli-

- Anti-rabies injection given to a dog
- Antirabies vaccine given to human
- Tetanus toxoid given to human
- Antitetanus vaccine given to human

2019 AL

(A) (i) State three main differences between active immunity and passive immunity.

Active immunity Passive immunity

……
……
……
……

2020 AL

Briefly describe what interferons are

……
……
……
……

Answers/Structures Essays

1. The state of being resistance to injury, invading pathogens and foreign substances through defensive mechanisms in the body.
2. Innate immunity and Acquired immunity (Adaptive immunity)
3. Ability to resist damage or diseases through inherent body defenses which offer rapid responses against broad range of pathogens and foreign substances.
4. External barriers and Internal nonspecific defenses
5. Skin, Mucous membranes, Secretions (tears, saliva, mucus)
6. Phagocytic cells, Natural killer cells, Antimicrobial proteins, Inflammatory responses
7. Phagocytic cells, Natural killer cells,
8. Neutrophils and Macrophages
9. Natural killer cells do not engulf abnormal cells but release chemicals to kill virus-infected cells and cancerous cells
10. Proteins present in blood and interstitial fluids which function in innate defense by attacking microbes directly or impeding their reproduction
11. Interferons and Complement proteins
12. Interferons are proteins secreted by virus-infected cells that protect uninfected cells by interfering with viral replication and activating macrophages
13. Complement proteins are normally inactive proteins in blood plasma that when activated lead to lysis of invaded cells and promote phagocytosis and inflammatory response
14. Innate immune defense response in body to tissue damage triggered by microbial infections or injury of tissues
15. Histamine causes increased permeability and dilation of nearby blood vessels, enhancing infiltration of white blood cells and other immune components
16. Redness, heat, swelling and pain
17. Cytokines promote blood flow to injured/infected site and can cause further histamine release
18. Ability of body to defend itself against invading foreign agents through specific defense responses mediated by T and B lymphocytes
19. (i) Specificity for particular foreign molecules
    (ii) Recognition of self from non-self molecules
    (iii) Memory for previously encountered pathogens
20. T lymphocytes mature in thymus, B lymphocytes mature in bone marrow
21. Substances that can stimulate immune response through T and B lymphocytes and react with specific cells or antibodies
22. Viral proteins, bacterial toxins, chemical components of bacterial structures (flagella and cell walls), structural components of incompatible blood cells, transplanted tissues
23. Epitope
24. Cell mediated immune responses and Humoral immune responses
25. B lymphocytes attach to antigens, undergo proliferation, differentiate into plasma cells that secrete antibodies to neutralize toxins and pathogens

35. State some common allergens
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.....
.....

36. State some of the symptoms of typical allergy.
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.....

37. What is an autoimmune disease.
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.....

38. What are possible reasons for auto immune diseases
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.....

39. Why auto immune diseases are more common in females than males.
.....
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.....
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40. What are different mechanisms produce different autoimmune diseases.
.....
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.....

41. Give some examples for autoimmune diseases.
.....
.....
.....

42. Define Immunodeficiency diseases
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.....
.....

43. What are two types of immunodeficiency diseases.
.....
.....
.....

44. What causes acquired immunodeficiency
.....
.....
.....

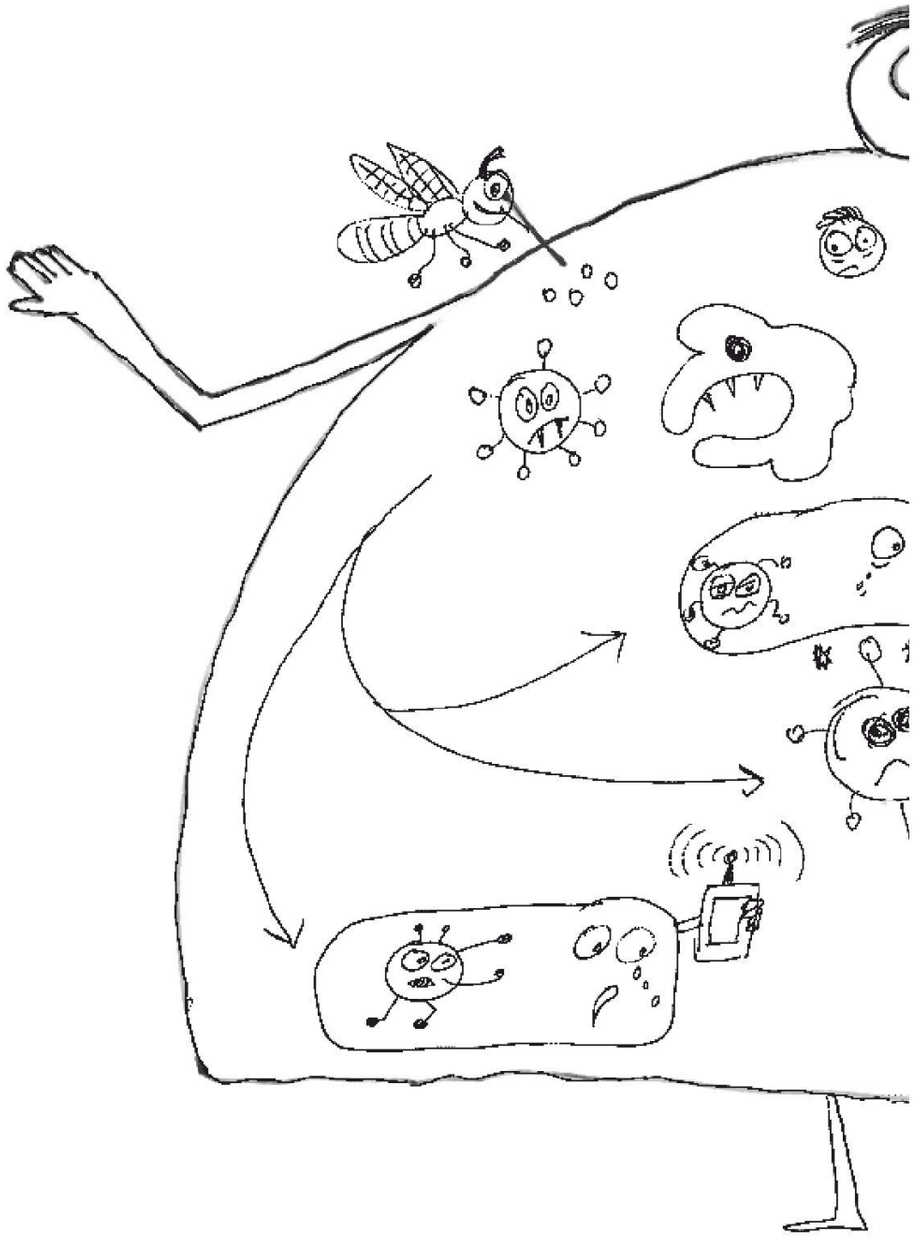
45. What are drugs causing acquired immunodeficiency
.....
.....
.....

46. State the type of acquired immunity involve in following states.
    - Resistance against chickenpox at second time of infection.
    - Protection to the child due to mothers antibodies
    - Prevention of polio by oral vaccines.

cation within these neighboring cells. Some interferons activate …….. which enhance the phagocytic activity. ……. proteins are a group of normally inactive proteins in the blood plasma and plasma membranes. When they are activated by different substances present on the surfaces of microbes, a ……..... of biochemical reaction occurs which lead to ……..…….. of invaded cells. They also promote phagocytosis and inflammatory response.

- **Inflammatory response:** This is an innate immune defense response in the body to tissue damage triggered by ……. …….. or …….. of the tissues. This involves the release of substances that promote increased …….. and dilation of ……. vessels. enhance migration of phagocytes, destruction of invading pathogens and aid in tissue repair (Figure 5.31). Inflammation attempts to destroy the microbes at the site of the injury preventing the spread to other tissues and promote tissue repair.

Inflammatory response is brought about by various signaling molecules upon infection or injury. ……. is one of the important inflammatory signaling molecules released mainly by …….. cells in the connective tissues at the site of damage. Histamine causes increased ……. and ……... of nearby blood vessels (blood capillaries). Increased permeability of the blood vessels enhance the infiltration of white blood cells, antimicrobial proteins and clotting elements to enter the injured area from the blood that aid in destruction of invading pathogens and tissue repair. Dilation of blood vessels allows ……... blood to flow through the damage area which helps to remove …….. cells. Activated phagocytes (macrophages and neutrophils) moved from the blood to the damaged tissue area can also discharge signaling molecules (……...) which also promote blood flow to the injured or infected site. During inflammation, activated complement proteins can cause further histamine release which attracts more phagocyte cells to enter injured tissue and carry out additional …….. This process can digest the microbes and cell debris at the site of injury.



28. Give examples for antigen presenting cells
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.....
.....

29. What happens to activated B or T lymphocytes.
.....
.....
.....

30. What are the 2 types of effector forms of T lymphocytes.
.....
.....
.....

31. What is the effector forms of B lymphocytes
.....
.....
.....

32. What are memory cells and how they are important in immunity. Explain based on the diagram.
.....
.....
.....

33. Humoral immunity can be classified as follows
(a) What is meant by a passive immunity and an active immunity
.....
.....
.....

(b) What is the difference between natural and artificial immunity
.....
.....
.....

(c) State how naturally acquired passive immunity is developed in a child.
.....
.....
.....

(d) Give an example for naturally acquired active immunity.
.....
.....
.....

(e) State how artificially acquired active immunity against tetanus can be developed.
.....
.....
.....

(f) Explain the importance of artificially acquired passive immunity.
.....
.....
.....

34. What is an allergic reaction.
.....
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.....

15. Explain the role of histamine in inflammatory responses.
……
……
……

17. State signs and symptoms of inflammation.
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……
……

17. State the role of cytokines in inflammation.
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18. What is acquired immunity.
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19. State 3 main properties of acquired immunity
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……
……

20. State the reason to name lymphocytes as T and B.
……
……
……

21. What are antigens
……
……
……

22. What can act as antigens
……
……

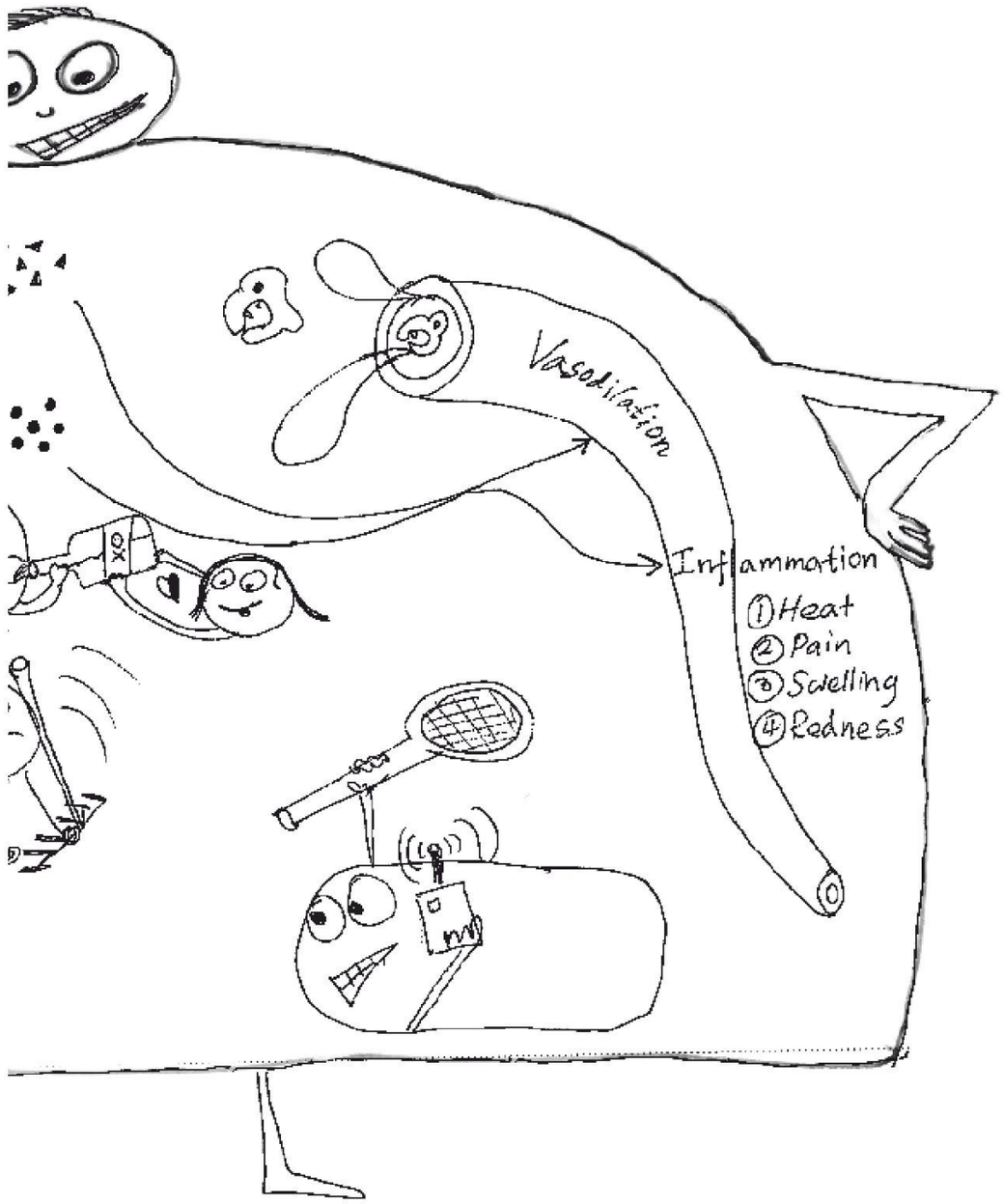
23. What do you called the small accessible portion of the antigen that binds to a specific antigen receptor of a T lymphocyte or B lymphocyte.
……
……

24. What are the 2 types of immune responses mediated by T and B lymphocytes.
……

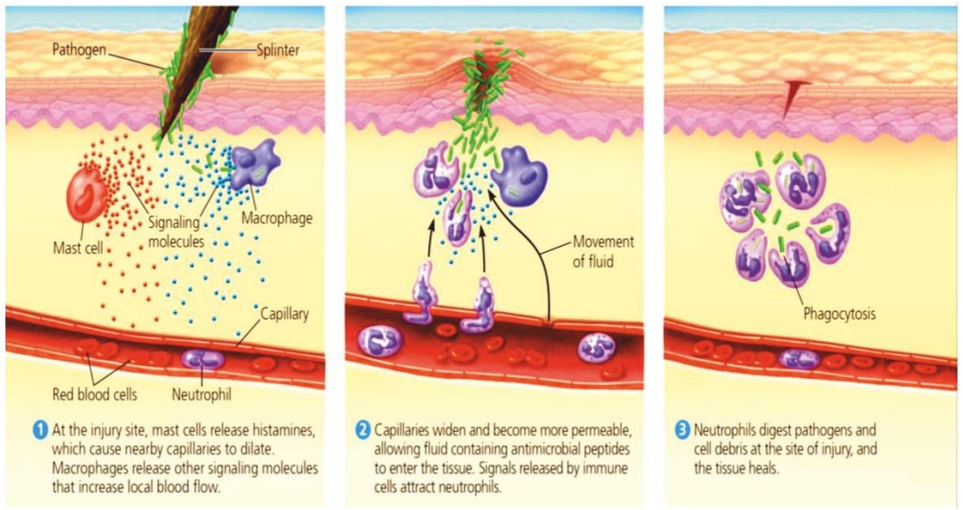
25. Briefly describe the events in humoral immune response.
……
……
……

26. What are antibodies
……
……
……

27. Out of B and T lymphocytes what is the cell type needs antibody presentation.
……
……



Signs and symptoms of inflammation are ……., ……., ……... and ……..... Dilation of blood vessels causes redness and heat production due to high metabolism in the area. Increased permeability of blood vessels triggers localized swelling due to leaking of tissue fluid into neighboring tissues. Pain results from injury to neurons and microbial …….. As a result of most inflammatory responses, pus may be accumulated. It is a fluid rich in dead phagocytes, dead pathogens and cell debris from the damaged tissue. Minor injury or infection causes a …….. inflammatory response If the injury or infection is severe it may lead to a systemic response (throughout the body) leading to ……..... Elevated body temperature within limits may enhance the phagocytosis and accelerate tissue repair by speeding up the chemical reactions.



Acquired Immunity (Adaptive Immunity)

Acquired immunity is the ability of the body to defend itself against invading foreign agents (e.g. pathogens) through specific defense responses mediated by diverse T lymphocytes and B lymphocytes. Acquired immunity shows

(i) ……

……

(ii) ……

……

(iii) ……

Structured Essay

1. Briefly explains what is immunity
   ……
   ……
   ……
2. Names the two types of immunity
   ……
3. Defines the term innate immunity
   ……
   ……
   ……
4. What are the two types of innate immunity.
   ……
   ……
   ……
5. What are components of external defenses
   ……
   ……
6. What are components of internal defenses
   ……
   ……
   ……
7. What are different cell types involve in internal defenses of innate immunity
   ……
8. State different phagocytotic cells in the immune system
   ……
9. State why the natural killer cell is not considered as a phagocyte
   ……
   ……
10. What are antimicrobial proteins
    ……
    ……
    ……
11. Give some examples for antimicrobial proteins
    ……
12. Briefly describe its activity of interferon.
    ……
    ……
    ……
13. State what are complement proteins.
    ……
    ……
    ……
14. Define inflammatory response
    ……
    ……
    ……

(3) Destroying helper T cells, leading to collapse of both cellular and humoral immunity
(4) Preventing innate immune responses (5) Enhancing autoimmune responses

46. Secondary immune responses are more effective because:
(1) Primary responses are completely blocked
(2) Memory cells enable faster antibody production and stronger cellular responses
(3) No memory cells are involved (4) Only innate immunity is activated (5) Inflammation occurs immediately

47. Immunodeficiency results in frequent infections because:
(1) Memory cells form too quickly (2) Only innate immunity is overactive
(3) T cells become hyperactive
(4) The immune system lacks or has defective components needed for proper pathogen defense
(5) Antibodies attack normal cells

48. The gender difference in autoimmune disease occurrence shows:
(1) Age is the only determining factor (2) Males are always more susceptible
(3) Females are more frequently affected due to genetic and environmental factors
(4) Gender has no influence on occurrence (5) Only hormones determine susceptibility

49. The role of antigen receptors on lymphocytes is:
(1) To prevent immune responses (2) To produce antibodies immediately
(3) To activate only innate immunity (4) To kill pathogens directly on contact
(5) To recognize specific molecular patterns and initiate appropriate immune responses

50. In the development of immunity, T lymphocytes mature in:
(1) Blood circulation only (2) Skin tissue only (3) Thymus, where they develop specific antigen receptors
(4) Bone marrow, like B cells (5) Lymph nodes only

51. The relationship between helper T cells and B cells in immune response is:
(1) They work independently without interaction (2) Helper T cells inhibit B cell function
(3) B cells activate helper T cells
(4) Helper T cells provide signals necessary for B cell activation and antibody production
(5) They compete for antigen recognition

52. The cells that mediate internal defences in innate immunity in man are
(1)T cells and B cells. (2) T cells and phagocytes. (3) B cells and phagocytes.
(4) natural killer cells and T cells. (5) natural killer cells and phagocytes. 2019/22

53. Select the correct statement regarding antibodies.
(1) They have several epitopes for binding with specific antigens.
(2) They have the same Y—shaped structure as T lymphocyte antigen receptors.
(3) They can be transferred to another person to induce immunological memory.
(4) They can directly destroy specific pathogens in blood.
(5) They hind with specific antigens to activate the complement system. 2022/23

MCQ Answers

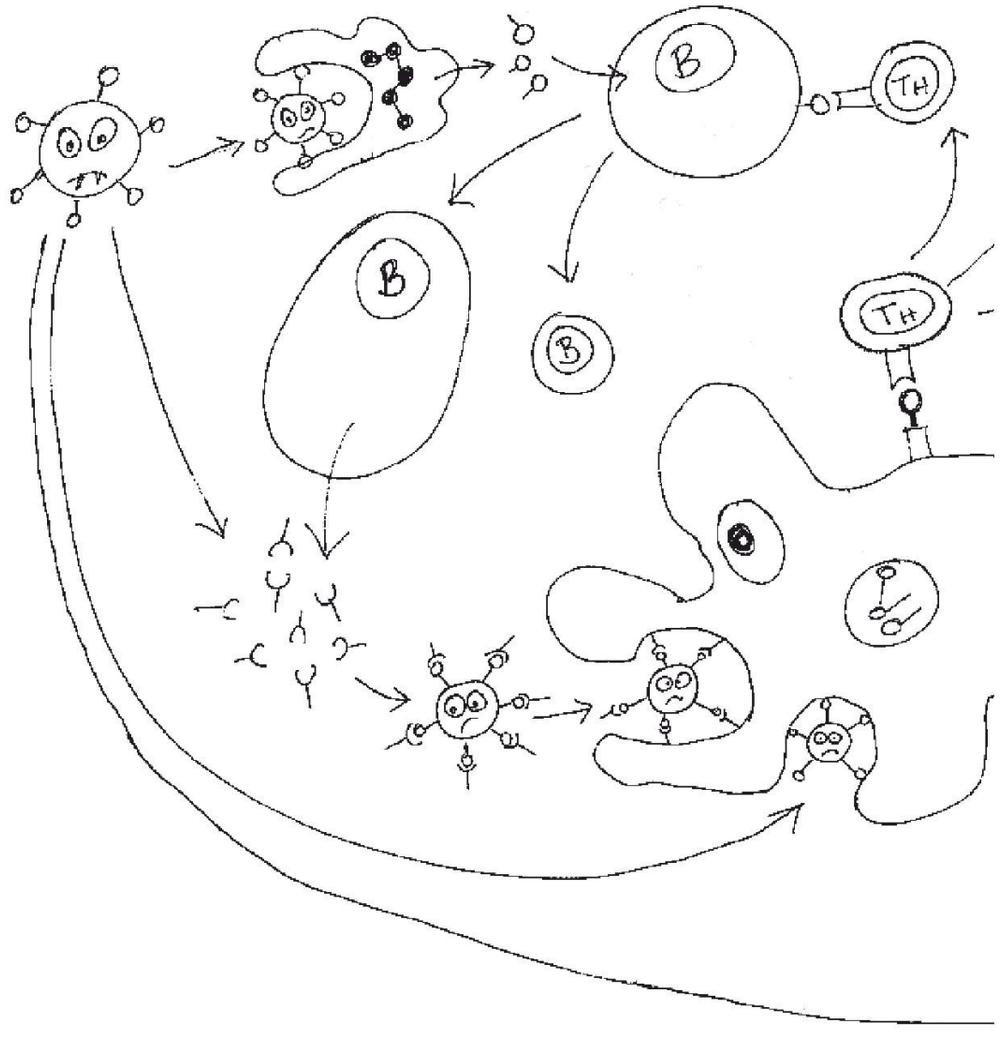
1.(1)	2.(3)	3.(5)	4.(1)	5.(2)	6.(1)	7.(4)	8.(1)	9.(5)	10.(1)
11.(3)	12.(1)	13.(2)	14.(5)	15.(2)	16.(5)	17.(3)	18.(1)	19.(1)	20.(3)
21.(4)	22.(3)	23.(4)	24.(5)	25.(2)	26.(5)	27.(4)	28.(3)	29.(5)	30.(5)
31.(3)	32.(2)	33.(3)	34.(5)	35.(3)	36.(4)	37.(3)	38.(4)	39.(4)	40.(3)
41.(2)	42.(5)	43.(3)	44.(4)	45.(3)	46.(2)	47.(4)	48.(3)	49.(5)	50.(1)
51.(4)	52.(5)	53.(5)							

(immunological memory). In the animal kingdom, acquired immunity is found only in the vertebrates.

The cells that have developed the ability to carry out acquired immune responses if they are activated against foreign agents are called …….. lymphocytes and …… lymphocytes. In man, both types of lymphocytes are originated from ……... cells in the ……... ……... Some of the lymphocytes that migrate to thymus for maturation are called T lymphocytes (T cells). The lymphocytes that remain in the bone marrow for completion of development are called B lymphocytes (B cells). Before leaving these lymphocytes to the secondary lymphatic tissues, their plasma membranes acquire diverse specific protein receptors (antigen receptors) which have the ability to recognize specific foreign invasions (There can be over ……. antigen receptors on the surface of a single B lymphocyte or T lymphocyte)

……
……
……
……...

Viral proteins, bacterial toxins and chemical components of bacterial structures such as flagella and cell walls can be antigenic. Structural components of ……
……..., ……. can also be antigenic. Antigens are usually ……. foreign molecules such as ……... and ……...
In general not the entire antigen, but certain parts of a large antigen molecule act as the triggers for the acquired immune responses. The ……... ……. portion of the antigen that binds to a specific antigen receptor of a T lymphocyte or B lymphocyte is called an ……... (for example a group of amino acids in a large protein). Can serve as an epitope. Usually a single antigen has several epitopes (Figure 5.32) each can bind with a specific antigenic receptor of the single T or B lymphocyte.



(3) Plasma cells only form during second exposure (4) Memory cells directly kill pathogens
(5) Plasma cells provide immediate antibody protection while memory B cells ensure long-term immunity

35. The effectiveness of vaccines depends on:
(1) Direct transfer of antibodies to the recipient (2) Prevention of memory cell formation
(3) Their ability to stimulate memory cell formation without causing disease symptoms
(4) Immediate killing of all pathogens (5) Activation of only innate immunity

36. The reason passive immunity provides only temporary protection is:
(1) The recipient's immune system rejects antibodies (2) Memory cells are destroyed by transferred antibodies
(3) It only activates innate responses
(4) Transferred antibodies eventually degrade and no memory cells are formed
(5) It prevents natural immunity development

37. The key feature that makes acquired immunity "acquired" is:
(1) It's part of innate immunity (2) It works the same way for all pathogens
(3) It develops specific responses through exposure to pathogens or vaccines
(4) It's present from birth without exposure (5) It doesn't require memory formation

38. Memory cells differ from effector cells because:
(1) They provide only immediate responses (2) They don't recognize specific antigens
(3) They work in innate immunity only
(4) They survive long-term and initiate rapid responses upon re-exposure to specific antigens
(5) They prevent long-term immunity

39. BCG vaccine provides protection through:
(1) Prevention of memory cell formation (2) Direct antibody transfer to the recipient
(3) Blocking all immune responses initially
(4) Using attenuated bacteria to stimulate specific immunity without causing disease
(5) Activation of only innate immunity mechanisms

40. In autoimmune diseases, the immune system's error is:
(1) Complete lack of immune response (2) Inability to form memory cells
(3) T cells and antibodies mistakenly attack the body's own healthy tissues
(4) Failure to recognize any foreign antigens (5) Overactivation of only innate immunity

41. Allergic reactions develop because:
(1) Memory cells fail to form against allergens
(2) The immune system overreacts to normally harmless substances by producing specific antibodies
(3) There is no immune response to allergens (4) T cells cannot recognize allergens
(5) Innate immunity stops working

42. Multiple sclerosis develops when:
(1) No immune cells are produced (2) Memory cells attack blood cells (3) Only B cells become defective
(4) Innate immunity fails completely
(5) T cells attack myelin sheaths around neurons causing nerve signal disruption

43. Type 1 diabetes mellitus occurs because:
(1) Memory cells fail to develop (2) Only innate immunity is affected
(3) The immune system specifically destroys insulin-producing pancreatic beta cells
(4) Antibodies cannot be produced (5) All pancreatic cells are damaged

44. The difference between allergic and autoimmune responses is:
(1) Both affect only innate immunity (2) Neither involves memory cells
(3) Both target only external substances
(4) Allergies target external harmless substances while autoimmune responses attack self-tissues
(5) Both work through the same mechanism

45. HIV specifically affects immune function by:
(1) Only affecting antibody production (2) Blocking only inflammatory responses

24. The process of memory cell formation in acquired immunity results in:
(1) All lymphocytes becoming plasma cells immediately (2) Temporary protection lasting few days
(3) Only innate immune responses (4) Immediate production of all antibody types
(5) Some lymphocytes remaining as long-lived cells that respond rapidly to future infections

25. The recognition of antigens by lymphocytes is characterized by:
(1) All lymphocytes recognizing all types of antigens equally
(2) Only a small fraction of lymphocytes having receptors specific for any particular epitope
(3) Direct killing of pathogens upon recognition (4) Random binding without specific receptors
(5) Every lymphocyte having receptors for every possible antigen

26. The role of T helper cells in immune response is:
(1) They prevent immune responses from occurring (2) They only kill virus-infected cells
(3) They directly produce antibodies against pathogens (4) They only activate innate immunity
(5) They activate both cytotoxic T cells for killing infected cells and B cells for antibody production

27. Naturally acquired active immunity differs from artificially acquired active immunity because:
(1) Vaccines work through innate immunity only (2) Natural infection doesn't create long-term immunity
(3) Vaccination provides immediate antibodies
(4) Natural infection triggers immune response while vaccination uses modified pathogens to stimulate protection
(5) Only natural infection produces memory cells

28. The advantage of immunological memory in acquired immunity is:
(1) It works against all pathogens equally (2) Memory prevents any future infections
(3) Memory cells enable faster and stronger responses when encountering the same pathogen again
(4) It provides immediate protection against all new pathogens
(5) It activates only innate immunity responses

29. How do cytotoxic T cells contribute to immune defense?
(1) They only work in innate immunity (2) They only activate other immune cells
(3) They prevent inflammation from occurring (4) They produce antibodies against pathogens
(5) They release toxic proteins that directly kill infected cells after recognizing specific antigens

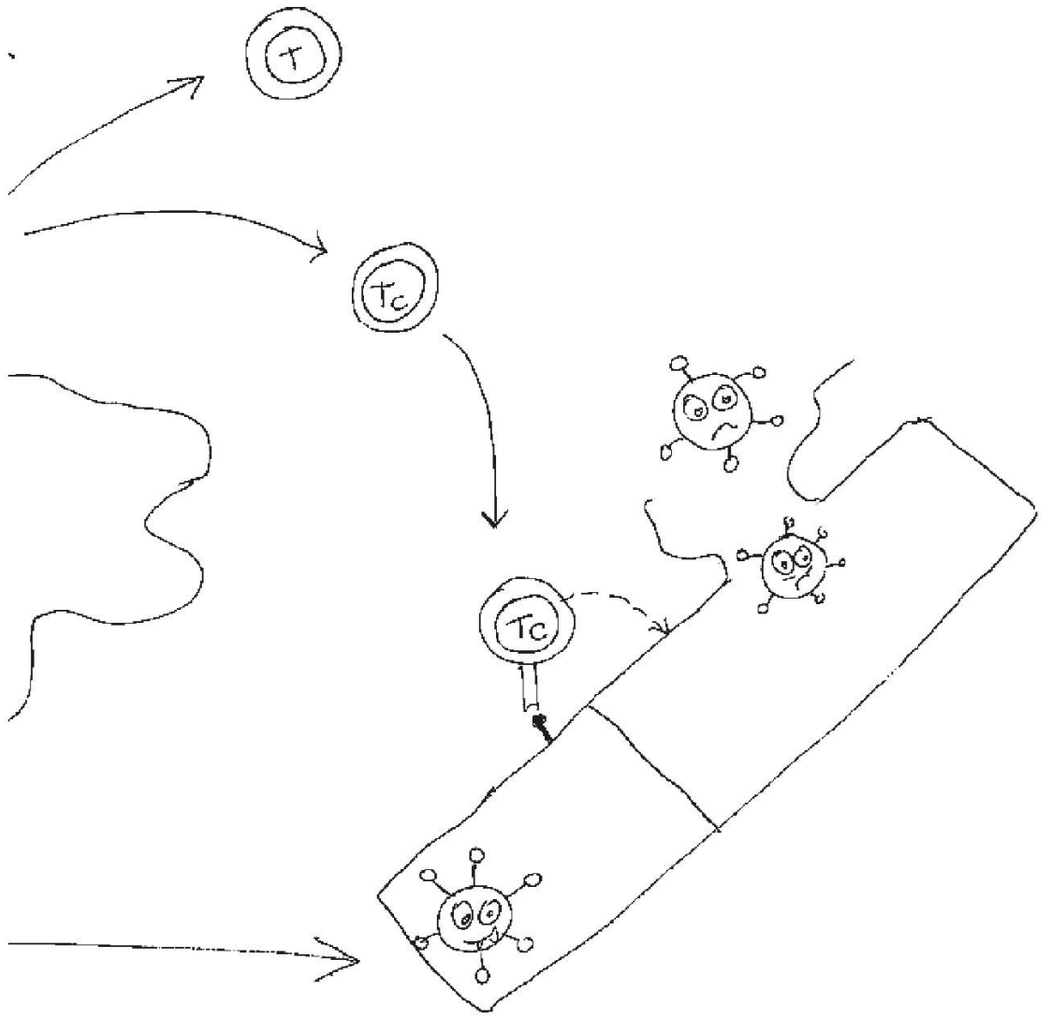
30. Which best describes how plasma cells develop from B lymphocytes?
(1) B cells need pathogen contact to become memory cells only
(2) All B cells directly transform into plasma cells upon first exposure
(3) B cells only produce antibodies without forming plasma cells
(4) Plasma cells form spontaneously without antigen contact
(5) Single activated B cells divide repeatedly to form thousands of plasma cells producing specific antibodies

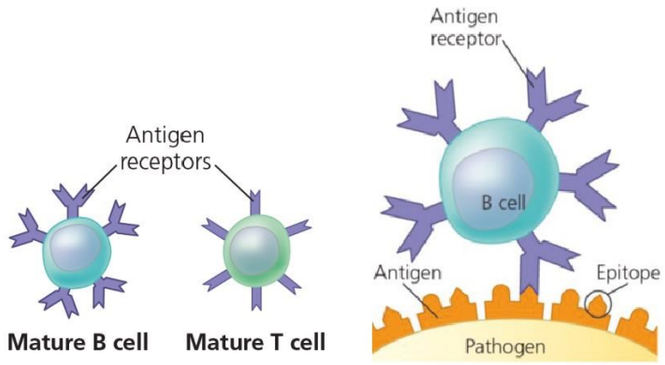
31. The difference between naturally and artificially acquired passive immunity is:
(1) Artificial transfer produces memory cells (2) Natural transfer works through T cells only
(3) Natural transfer occurs through placenta/breast milk while artificial involves injection of prepared antibodies
(4) Natural transfer creates permanent immunity (5) Artificial transfer activates innate immunity

32. Antigen presenting cells are important because:
(1) They kill pathogens immediately
(2) They process and display antigen fragments allowing T cells to recognize specific threats
(3) They prevent immune responses (4) They only activate innate immunity
(5) They directly produce antibodies against pathogens

33. The relationship between epitopes and antigen receptors is:
(1) Receptors recognize only whole antigens (2) Binding leads to immediate pathogen destruction
(3) Each epitope binds specifically to matching receptor, triggering only appropriate immune responses
(4) All epitopes bind to all receptors equally (5) Epitopes prevent receptor activation

34. When B lymphocytes are activated, they form two cell types because:
(1) Memory cells prevent plasma cell formation (2) Both cell types only produce immediate antibodies





In acquired immunity, two types of immune responses are mediated by T lymphocytes and B lymphocytes. They are …….. immune responses and …….. immune responses. Humoral immune response is also called as ……... Both immune responses are triggered by antigens. A given pathogen may provoke both types of immune responses.

Cell mediated immune response

Cell mediated immune response is a type of acquired immunity in which specifically sensitized T lymphocytes attach to the antigen undergo proliferation and eventually differentiate into "Cytotoxic T cells" that can directly kill the cells with the invading antigen. In addition "Memory T cells" are formed that can cause ……. and more …….. response at the subsequent encounter of the same antigen to the body.

This is particularly effective against …….. cells (fungi, parasites and virus that are present within host cells), some …….. cells and foreign ……. ……..... Cell mediated immunity always involves cells attacking cells.

Humoral immune response

Humoral immune response is a type of acquired immunity in which specifically sensitized B lymphocytes attach to a particular …….. undergo proliferation and eventually differentiate into "…….. ……..." that secrete circulating antibodies that can neutralize and inactivate the specific toxins and pathogens in the blood and lymph. In addition "……." are formed that can cause stronger and more rapid response at subsequent encounter of the ……. antigen. Humoral immune response works mainly against antigens present in body fluids and extracellular pathogens (mainly bacteria) that multiply in the body fluids.

14. Why does increased permeability of blood vessels during inflammation contribute to pathogen destruction?
(1) It directly kills all pathogens in the blood vessels (2) It prevents pathogen entry through the skin barrier
(3) It stops histamine production by mast cells (4) It reduces blood flow to the infected area
(5) It allows white blood cells and antimicrobial proteins to enter the injured area from the blood

15. Natural killer cells differ from phagocytes in their mechanism of action because they:
(1) Only function in acquired immunity responses
(2) Release chemicals to kill infected cells without engulfing them (3) Cannot recognize abnormal cells
(4) Only work against bacterial infections (5) Require engulf of cells

16. Which statement best explains how mucous membranes provide multiple levels of protection?
(1) They only provide a physical barrier against pathogens
(2) They only produce chemical substances to kill microbes
(3) They directly activate the inflammatory response
(4) They produce specific antibodies against pathogens
(5) They produce mucus to trap microbes and use ciliated cells to sweep them away

17. The relationship between interferons and virus-infected cells is best described as:
(1) Interferons directly kill virus-infected cells immediately
(2) Virus-infected cells prevent interferon production
(3) Infected cells release interferons that protect nearby cells by triggering antiviral protein production
(4) Interferons function in acquired immunity
(5) Interferons prevent inflammation from occurring

18. Why is severe infection more likely to cause systemic rather than localized inflammation?
(1) Large amounts of pathogens trigger widespread immune responses throughout the body
(2) Localized responses cannot occur in severe infections
(3) Systemic responses are always faster than local ones (4) Severe infections only affect the blood system
(5) Phagocytes cannot respond to severe infections

19. How do phagocytes and complement proteins work together in innate immunity?
(1) Complement proteins enhance phagocytosis while phagocytes remove destroyed pathogens
(2) They only function independently of each other (3) Complement proteins prevent phagocytosis
(4) Phagocytes inhibit complement activation (5) Both only work in acquired immunity

20. The primary difference in the protective mechanism of interferons and complement proteins is:
(1) Both directly kill virus-infected cells (2) Both only activate inflammation
(3) Interferons prevent viral replication in neighboring cells, while complement proteins cause lysis of invaded cell.
(4) Both only enhance phagocytosis (5) Both prevent pathogen entry

21. Which statement correctly contrasts the end results of interferon and complement protein action?
(1) Both lead to direct pathogen destruction (2) Both result in antibody production
(3) Both cause only inflammation
(4) Interferons lead to anti-viral protein production, while complement proteins promote both cell lysis and inflammation
(5) Both only activate phagocytes

22. The primary characteristic of acquired immunity is:
(1) It works the same way for all types of invaders (2) It provides immediate non-specific responses
(3) It requires previous pathogen exposure and provides stronger responses in subsequent encounters
(4) It does not involve memory formation (5) It is found in all animal groups

23. T lymphocytes differ from B lymphocytes in antigen recognition because:
(1) Both need helper cells for recognition (2) Both recognize all antigens directly in blood
(3) Both can only recognize processed antigens
(4) T cells only recognize fragments presented by antigen-presenting cells, while B cells can recognize free antigens
(5) Neither can recognize free antigens

Innate Immunity Questions

1. The first line of defense in innate immunity consists of:
(1) Physical barriers and secretions (2) Antibodies and complement (3) T cells and B cells
(4) Memory cells and plasma cells (5) Cytokines and interferons

2. The skin prevents microbial entry through:
(1) Phagocyte activity (2) Antibody secretion (3) Keratinized layers (4) Memory cell production
(5) Complement activation

3. Mucous membranes are not found in:
(1) Respiratory tract (2) Urinary tract (3) Digestive tract (4) Reproductive tract (5) Blood vessels

4. Lysozyme:
(1) Break all bacterial cell walls (2) Preset in tears, saliva, semen and mucous (3) is an Enzyme
(4) Physical barrier (5) Gives acidity

5. Internal defenses are activated:
(1) With antibody production (2) When pathogens break external barriers (3) By forming memory cells
(4) Recognition of animals own molecules from non self molecules
(5) Destroy cell wall of some bacteria by lysozymes

6. The acidic environment of the stomach:
(1) Destroys ingested toxins (2) Prevent growth of bacteria (3) Provide protection against irritants
(4) Provide continuous washing (5) Physical barrier to entrance of microorganisms

7. Mucus primarily functions by:
(1) Provide acidity (2) Significant physical barrier
(3) Provide continuous washing (4) Trapping microorganisms (5) Destroy cell wall of some bacteria

8. Phagocytic cells include:
(1) Neutrophils and macrophages (2) B cells and T cells (3) Memory cells and plasma cells
(4) Mast cells and platelets (5) Natural killer cells

9. Natural killer cells:
(1) are type of phagocytotic cell (2) Bind to foreign cells and release chemicals to kill
(3) Inhibit further spread of Virus by promoting inflammation (4) Detect foreign cells with abnormal cell surface molecules. (5) kills virus-infected cells and cancer cells

10. The inflammatory response begins with:
(1) Tissue damage and infection (2) Release of interferons (3) Release of complement proteins
(4) T cell activation (5) B cell differentiation

11. Molecular recognition in innate immunity involves:
(1) Memory formation (2) Antibody production
(3) Receptor molecules on immune cells (4) Complement activation (5) T cell maturation

12. Which statement best explains why innate immunity is called non-specific defense?
(1) Its protective mechanisms function the same way regardless of invader type
(2) It only protects against specific pathogens that enter the body
(3) It requires previous exposure to pathogens to be effective
(4) It produces specific antibodies against each pathogen
(5) It only works in vertebrate animals

13. When skin is injured, the most likely sequence of events in the inflammatory response is:
(1) Tissue damage → histamine release → neutrophil migration → blood vessel dilation → phagocytosis
(2) Tissue damage → histamine release → blood vessel dilation → neutrophil migration → cytokine discharge
(3) Tissue damage → cytokine discharge → histamine release → phagocytosis → neutrophil migration
(4) Tissue damage → neutrophil migration → histamine release → blood vessel dilation → phagocytosis
(5) Tissue damage → phagocytosis → neutrophil migration → histamine release → blood vessel dilation

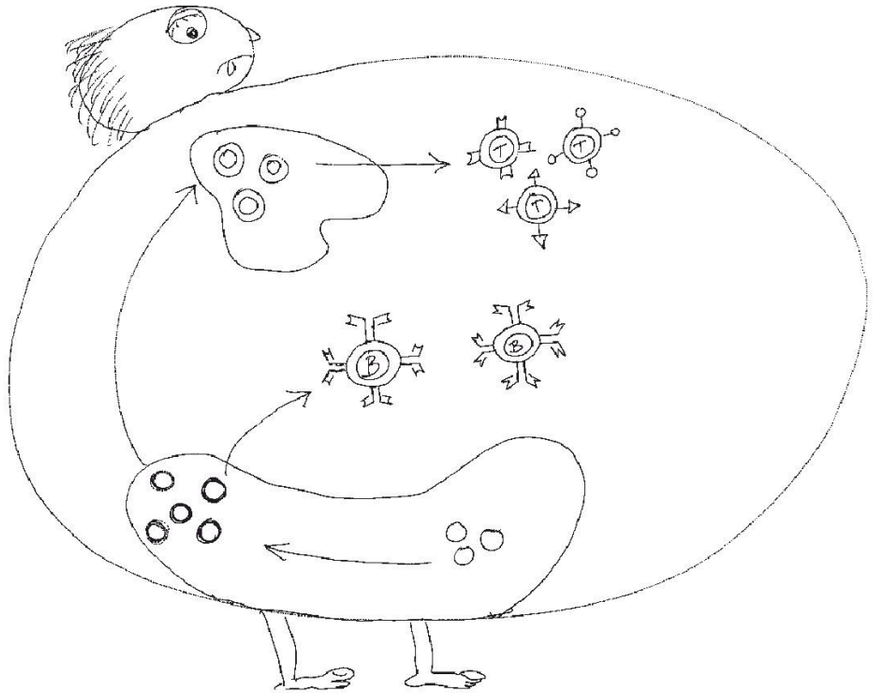
Antibodies

Antibodies are …….. secreted by plasma cells (differentiated B lymphocytes) in response to specific antigens: the antibody binds with that antigen to neutralize, inhibit or destroy it. Antibodies can neutralize and inactivate the specific …….. and …….. in the body fluids. The antibodies do not directly kill the pathogens but can interfere with activity of the pathogen or mark the pathogen for inactivation and destruction. Antibody-antigen complexes can activate complement system and phagocytosis to destroy the pathogen. Antibodies are also called as immunoglobulins. lmmunoglobulin has the same Y shaped structure as B lymphocyte antigen receptors but are secreted than membrane bound.

Role of T lymphocytes and B lymphocytes in acquired immunity

- **Recognition of the antigen, binding to the antigen and sensitization:**

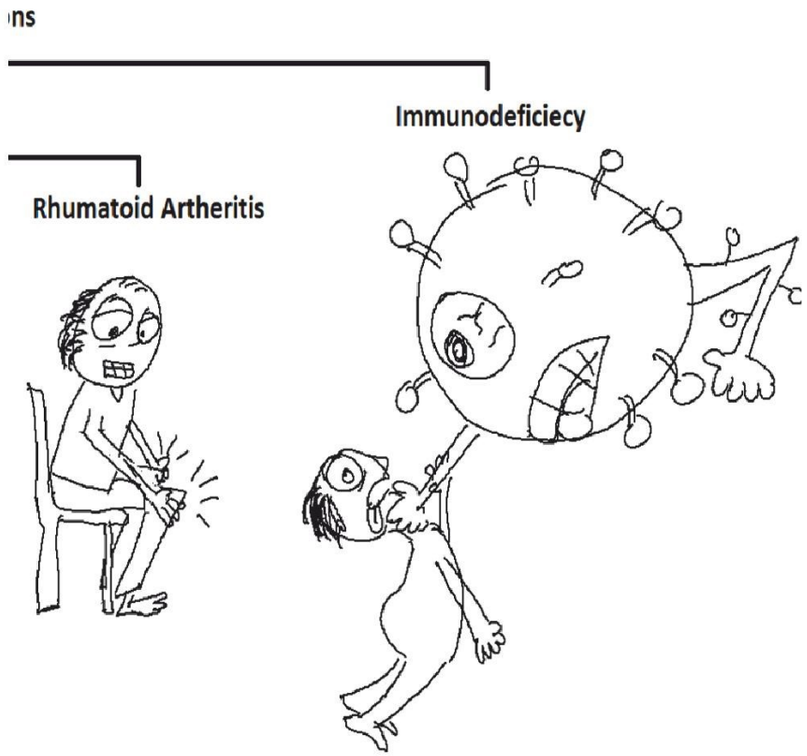
For an acquired immune response to occur, some T lymphocytes or B lymphocytes must first recognize that a foreign ..... is present in the body. Even though there are vast variety of ..... ……..... present on different B lymphocytes and T lymphocytes, only a very small fraction are specific for a particular ..... Hence, antigen should be presented to the B lymphocytes and T lymphocytes until a match is made. Recognition of the antigen occurs through successful match between an epitope of the antigen and an ……..... ..... on small number of B lymphocytes or T lymphocytes. As specific antigen receptors produced by a single T cell or B cell can be identical they can bind to the same ……..... Hence, both T and B cells can respond to any ..... that produces molecules containing that same epitope. But B cells and T cells encounter antigens in different ways. T lymphocytes only recognize the fragments of antigenic proteins that are presented to the cells by a special cells called "……..... ...." (macrophages, dendritic cells and B cells). However, B lymphocytes can recognize and bind to the antigens present in ....., ……..... and ..... The binding of an antigen to the specific antigen receptor results in ……..... (activation) of a specific T lymphocyte or B lymphocyte which initiates .... and .... immune response as described below.

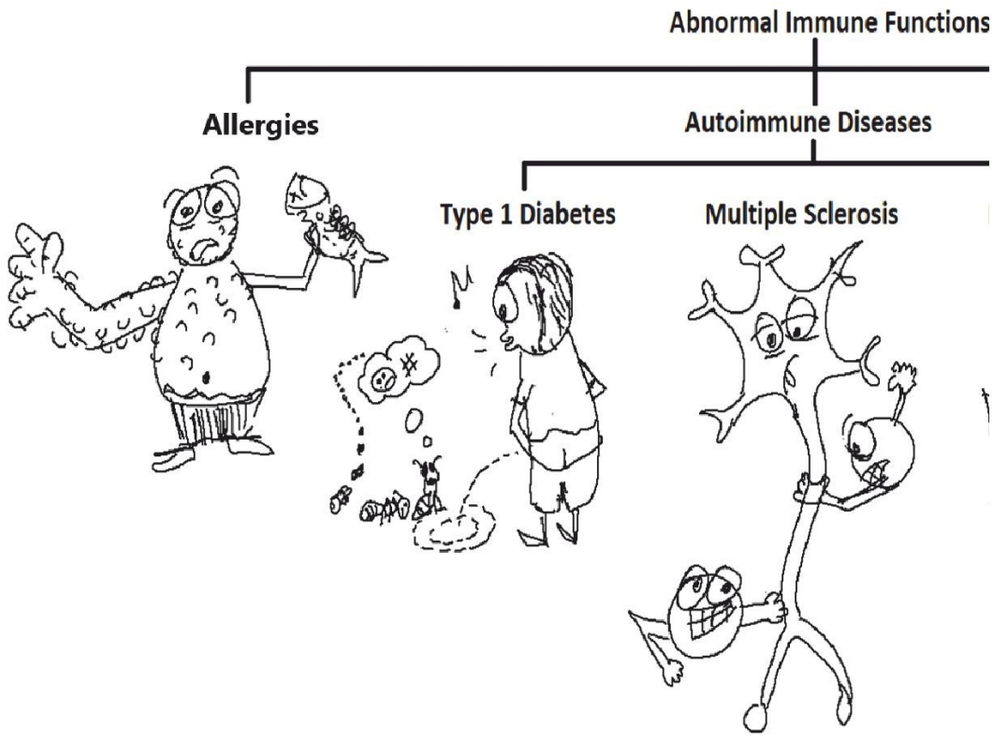


- **Proliferation and Differentiation into effector cells:** Lymphocyte or B lymphocyte undergoes multiple cell divisions (proliferations) resulting a clone, a population of cells that are identical to the original lymphocyte. Some cells of clones become Effectors cells which are short lived cells that take effect immediately against antigen to provide primary immune responses

- **Elimination of invaders:**

The effector forms of T lymphocyte are "....." and ".....". ..... use toxic proteins to …….. the cells infected with the pathogen. Signals from ..... activate cytotoxic T cells to kill the infected cells. Signals from Helper T cells can also activate ..... to initiate antibody production. Effector forms of B lymphocytes are ".....". A single activated B lymphocyte can form thousands of identical ..... The plasma cells begin producing and secreting a soluble form of the .... (.....) in large quantities which are released to the blood and lymph. Hence, circulating antibodies can ……..... and ..... the specific toxins and pathogens in the body fluids.





- **Provide immunological memory:**

Following differentiation into Effector T cells (Cytotoxic T cells and Helper T cells), other T lymphocytes in the clones remain as “Memory T cells" which are long lived that can give rise to Effector T cells if the same antigen is encountered later in the life. Similarly the remaining B lymphocytes in the clones are “Memory B cells" which are long lived that can give rise to Plasma cells if the same antigen is encountered later in the life. These Memory T cells and Memory B cells can cause stronger and more rapid response at subsequent encounter of the same antigen to the body. This immunological memory is called secondary immune responses

Active immunity

……

……

……

Active immunity can be developed as a result of natural infection of a pathogen or artificial immunization.

Naturally acquired active immunity

Long lasting immunity developed in the body against various infectious diseases in response to natural infections of ……..... is called .....

……..... ……..... ..... In response to a disease causing agent entering the body naturally for the first time (e.g. …….....

of .....), some ..... and .....

in the body become activated and eventually produce specific .....

.... and ..... to destroy the pathogen. ....

..... and .... produced in this process are long lived that will provide a stronger and rapid immune responses to destroy the particular

……..... if the same antigen (eg. Virus of Chickenpox) is encountered later in the life. In this way the body can resist to subsequent infections of the same .....

Artificially acquired active immunity

……

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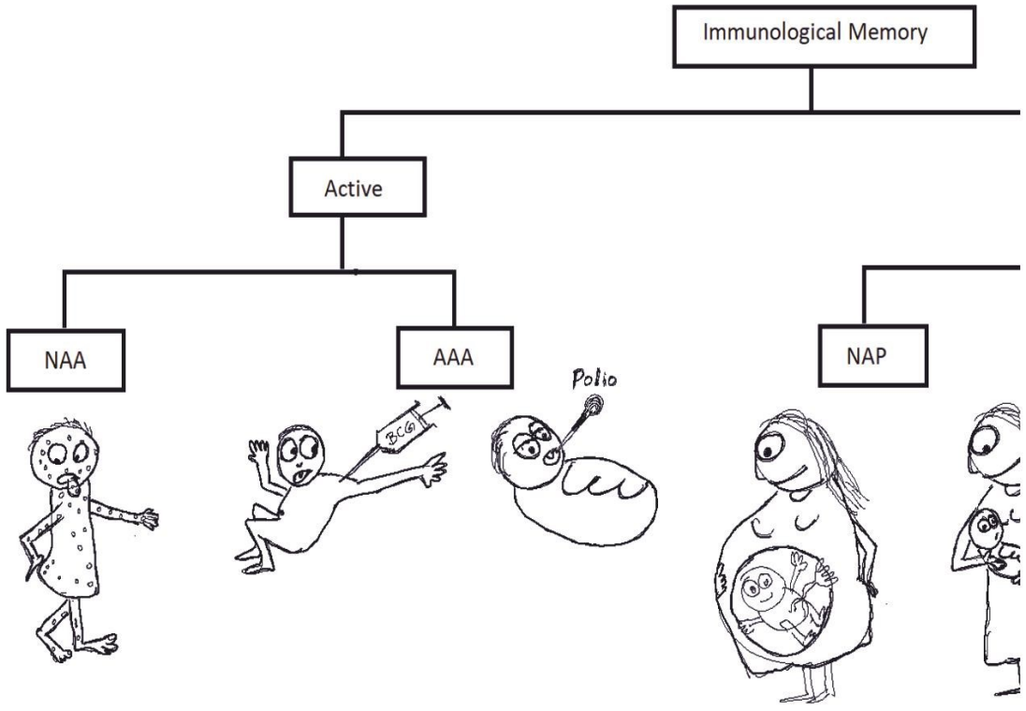
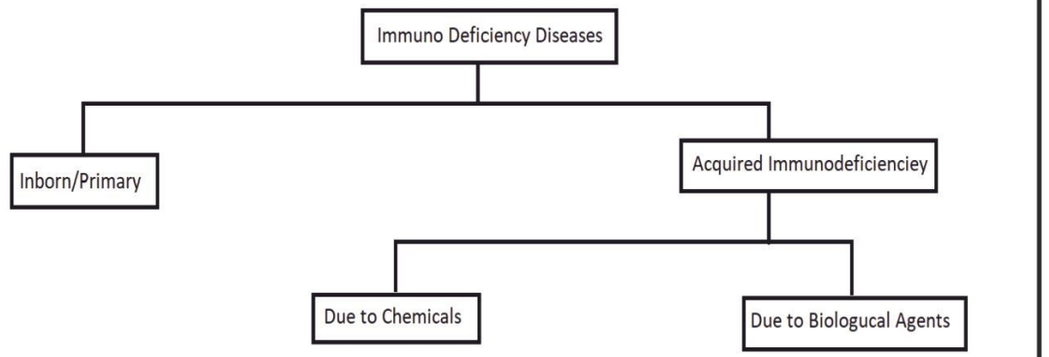
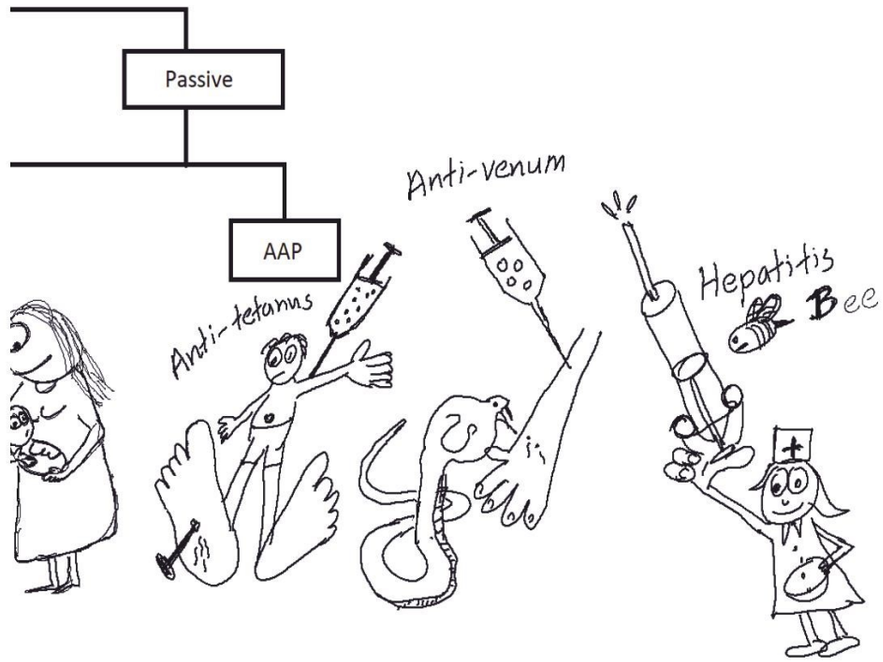

Immunological Memory
Active
NAA
AAA
NAP
BCG
Polio


Immuno Deficiency Diseases
Inborn/Primary
Acquired Immunodeficienciey
Due to Chemicals
Due to Biologucal Agents



Autoimmune diseases

Some persons are overly reactive to substances that are tolerated by most other people. ..... that induce ..... reactions in some persons are called ..... Exaggerated responses of the body to certain antigens (allergens) are called ..... Common allergens include ....., ……....., some ……..... (e.g. ....., ...), some ……..... (e.g. .....), venom from ..... and ……..... Whenever an allergic reaction takes place the .... occurs. The most allergens stimulate production of ……..... ..... which secrete ..... specific for the antigen. When the same allergen enter the body later, it become attach to the antibodies specific to the allergen which induce the .... to release ..... and other .... Acting on a variety of cell types these signals bring about typical ..... symptoms such as ....., ……..... ……....., ……..... ……..... and ..... ……..... ..... in the airways of the lungs that can result in breathing difficulties. An acute allergic conditions sometimes lead to ..... of the person due to ..... ……..... and ……..... .... with a few seconds of exposure to an allergen.

Immunodeficiency diseases

Immunodeficiency disease is a disorder in which responses of the immune system to antigens are defective or absent. An immunodeficiency can lead to frequent and recurrent infections and increased susceptibility to certain cancers. An inborn immunodeficiency results from a genetic or developmental defects in the production of immune system cells or specific proteins such as antibodies or proteins of the complement system. Acquired immunodeficiency can be developed later in life due to the exposure to chemicals or biological agents. Drugs used to fight autoimmune diseases or prevent transplant rejections suppress the immune system leading to an immunodeficiency state. The human immunodeficiency virus (HIV), the pathogen that cause Acquired Immunodeficiency Syndrome (AIDS) escapes and attacks the immune system of man. The HIV causes progressive destruction of immune responses in the person leading to frequent infections and increased susceptibility to certain cancers which can cause death.

Immunization can be carried out with preparations of …….. (vaccines) from many sources such as ……... or ……... pathogens, ……... bacterial cells or ……... encoding microbial proteins. These vaccines act as the antigens and stimulate …… ……..…….. and …….. mediated immune responses leading to production of long lived memory B and T cells to destroy the antigen. If the pathogen from which the ……... was derived, is …….. naturally later in the life, long lived memory cells can provide a stronger and rapid immune responses to destroy the particular pathogen. In general, the antigens used in the vaccines are pretreated to be immunogenic but not pathogenic.
For example, ……. vaccine which is used against …….. disease in man. has been prepared from a strain of the attenuated live tuberculosis bacteria. …….. vaccine consists of ……... ……. poliovirus strains. These antigens in the Polio vaccine produces antibodies in the blood against polio virus, and in the event of infection, this protects the individual by preventing the spread of poliovirus to the nervous system.

Passive Immunity

……
……
…….. Passive immunity provides immediate protection, but the body does not develop memory as passive immunity does not involve recipients' T cells and B cells. ……... immunity …….. only until the …….. ……... antibodies last (few weeks to few months). Therefore the recipient is at risk of being infected by the same pathogen later unless they acquire active immunity or vaccination. Passive immunity can be developed as a result of transferring antibodies to the recipient naturally or artificially.

Naturally acquired passive immunity

Short term …… mediated immunity for some infectious diseases can be developed within the body of the …….. or ……... …….. due to the natural transfer of …….. produced by the mother. The immunity occurs due to the transfer of antibodies to the fetus blood from mother's blood across the placenta. Antibodies also can pass from ……. to the …….. infant through the ……. and the ……... during breast feeding. The baby develops the resistance against some infectious diseases for a ……. time. In this way the infant may be protected

from these diseases until its own immunity system is ……... functional. This is known as naturally acquired ……. immunity.

Artificially acquired passive immunity

Artificially acquired passive immunity is a ……. induced defensive protection achieved by the transfer of ……... artificially to the blood of the recipient from another source. These …….. antibodies can be administered as blood plasma or serum (human or animal), or as injections of ……... human immunoglobulin from ……... donors or as …….. antibodies. Passive transfer of antibodies is used to prevent some infectious diseases when infectious agents are suspected to have accidently entered the body (e.g. readymade human serum antibodies for hepatitis A virus). It is also used in the …….. of several types of …….. infections (e.g. readymade human anti-tetanus immunoglobin for acute conditions of tetanus). Passive immunization is also used to treat poisoning from venomous snake bite (e.g. antivenin, serum prepared from horses that have been immunized against snake venom). Immunity derived from artificially acquired passive immunization lasts for few weeks to four months.

Allergies

Some persons are ……... ……... to substances that are tolerated by most other people. Antigens that induce hypersensitive reactions in some persons are called …….. Exaggerated responses of the body to certain antigens (allergens) are called ……... Common allergens include ……..., ……..., some …….. (e.g. Cuttlefish, Prawns, some antibiotics (e.g. penicillin), venom from honey bees and wasps. Whenever an allergic reaction takes place the tissue injury occurs. The most allergens stimulate production of plasma cells which secrete antibodies specific for the antigen. When the same allergen enter the body later, it become attach to the antibodies specific to the allergen which induce the mast cells to release ……. and other inflammatory ……...
Acting on a variety of cell types these signals bring about typical allergy symptoms such as sneezing, runny nose, teary eyes and smooth muscle contractions in the airways of the lungs that can result in breathing difficulties. An acute allergic conditions sometimes lead to …….. of the person due to breathing difficulties and low blood pressure With a few seconds of exposure to an allergen.