MCQs on Antibodies, Immunoglobulin Classes, and Antigen Receptor Genetics – Medical Immunology

Antibody Structure

1. **Which part of the antibody molecule determines its antigen-binding specificity?**

    A) Heavy chain constant region

    B) Light chain constant region

    C) Variable regions of both heavy and light chains

    D) Fc region

    E) Hinge region

2. **The Fc region of an antibody is responsible for:**

    A) Antigen binding

    B) Complement activation and Fc receptor binding

    C) Somatic recombination

    D) Affinity maturation

    E) Antigen presentation

3. **Which type of bond stabilizes the structure between antibody heavy and light chains?**

    A) Hydrogen bonds

    B) Ionic bonds

    C) Peptide bonds

    D) Disulfide bonds

    E) Hydrophobic interactions

4. **The hinge region of IgG antibodies provides:**

    A) Complement fixation site

    B) Antigen specificity

    C) Flexibility between Fab and Fc regions

D) Cross-linking with antigen

E) Heavy-light chain association

5. **A patient's serum electrophoresis shows a single monoclonal IgG peak. This finding is typical of:**

A) Normal immune response

B) Multiple myeloma

C) Common variable immunodeficiency

D) Chronic infection

E) Polyclonal activation

Antibody Classes and Effector Functions

6. **Which antibody class can cross the placenta to provide passive immunity to the fetus?**

A) IgA

B) IgD

C) IgE

D) IgG

E) IgM

7. **Which antibody class predominates in mucosal secretions such as saliva and tears?**

A) IgA

B) IgE

C) IgG

D) IgM

E) IgD

8. **IgM is particularly effective in complement activation because:**

A) It has high affinity

B) It binds Fc receptors strongly

C) It is a pentamer with multiple C1q-binding sites

D) It is the smallest antibody

E) It persists long-term

9. **Which antibody is most responsible for allergic reactions and defense against helminths?**

A) IgA

B) IgD

C) IgE

D) IgG

E) IgM

10. **In a patient with selective IgA deficiency, which of the following is expected?**

A) Increased mucosal infections

B) Defective complement activation

C) Impaired opsonization

D) Increased cytotoxic T-cell activity

E) Autoimmune hemolysis

Primary and Secondary Immune Responses

1. **Which immunoglobulin class predominates in the primary immune response?**

A) IgA

B) IgD

C) IgE

D) IgG

E) IgM

2. **Which of the following best describes the secondary immune response?**

A) Slow and low affinity

B) Mediated by naïve B cells

C) Rapid and high-affinity IgG response

D) Involves only T cells

E) Independent of memory cells

3. **The lag phase before detectable antibody levels is shorter in the secondary response because:**

A) T cells are more active

B) Memory B cells rapidly respond

C) Complement is faster

D) Antigen is larger

E) IgM is pre-formed

4. **A vaccine booster is given to:**

A) Enhance innate immunity

B) Induce tolerance

C) Stimulate memory B cells for stronger response

D) Prevent autoimmunity

E) Inhibit hypersensitivity

5. **In early infection, IgM predominates because:**

A) It has higher affinity

B) It is secreted first by plasma cells

C) It crosses placenta

D) It binds to Fc receptors

E) It has longest half-life

Antigen Receptor Genetics and Somatic Mutations

1. **V(D)J recombination occurs during:**

A) T-cell activation

B) B-cell antigen encounter

C) Lymphocyte development in primary lymphoid organs

D) Somatic mutation

E) Class switching

2. **The enzyme responsible for DNA cleavage during V(D)J recombination is:**

A) DNA polymerase

B) RAG1/2 recombinase

C) AID enzyme

D) DNA ligase IV

E) Terminal transferase

3. **Somatic hypermutation occurs in:**

A) Bone marrow

B) Thymus

C) Germinal centers

D) Liver

E) Red pulp of spleen

4. **Class switching of immunoglobulin genes is mediated by:**

A) RAG enzymes

B) DNA helicase

C) Activation-induced deaminase (AID)

D) RNA polymerase II

E) Exonuclease

5. **A patient with AID deficiency would most likely show:**

A) Hyper-IgM syndrome

B) Increased IgE levels

C) Absence of T-cell receptors

D) Loss of complement activation

E) Reduced IgM

6. **Which enzyme seals the DNA breaks during V(D)J recombination?**

A) DNA ligase IV

B) Polymerase δ

C) RNase H

D) RAG2

E) TdT

7. **Junctional diversity in antibodies arises mainly due to:**

A) Addition or deletion of nucleotides at gene joins

B) Class switching

C) Somatic hypermutation

D) RAG protein inactivation

E) IgM pentamer formation

8. **Terminal deoxynucleotidyl transferase (TdT) increases diversity by:**

A) Adding nucleotides to VDJ junctions

B) Splicing mRNA

C) Repairing thymine dimers

D) Degrading unused DNA

E) Methylating CpG islands

9. **Affinity maturation of antibodies occurs due to:**

A) Class switching

B) Somatic hypermutation and selection of high-affinity clones

C) RAG enzyme action

D) Complement activation

E) IL-2 signaling

10. **Mutation in RAG1/2 genes causes:**

A) SCID phenotype due to failure of antigen receptor gene rearrangement

B) Increased antibody affinity

C) Hyper-IgM syndrome

D) Complement overactivation

E) IgE-mediated allergy

Answers and Explanations

Antibody Structure

1. **Answer: C**

Explanation: The antigen-binding site (paratope) is formed by the variable regions of both heavy and light chains.

2. **Answer: B**

Explanation: The Fc region mediates effector functions such as complement activation and binding to Fc receptors on immune cells.

3. **Answer: D**

Explanation: Disulfide bonds stabilize the antibody's quaternary structure by linking heavy and light chains.

4. **Answer: C**

Explanation: The hinge region gives flexibility between Fab arms, allowing simultaneous binding to multiple epitopes.

5. **Answer: B**

Explanation: A monoclonal immunoglobulin peak (M-protein) indicates plasma cell proliferation, as in multiple myeloma.

Antibody Classes and Effector Functions

1. **Answer: D**

Explanation: IgG is the only antibody class that crosses the placenta through FcRn receptors.

2. **Answer: A**

Explanation: Secretory IgA provides mucosal defense by preventing microbial adherence.

3. **Answer: C**

Explanation: The pentameric structure of IgM allows strong activation of the classical complement pathway.

4. **Answer: C**

Explanation: IgE binds FcεRI on mast cells and basophils, triggering histamine release during allergy and anti-helminth responses.

5. **Answer: A**

Explanation: IgA deficiency causes recurrent mucosal infections, especially of the respiratory and gastrointestinal tracts.

Primary and Secondary Immune Responses

1. **Answer: E**

Explanation: IgM is produced first during a primary immune response by naïve B cells.

2. **Answer: C**

Explanation: Memory B cells generate a rapid, high-affinity IgG response upon re-exposure to antigen.

3. **Answer: B**

Explanation: Memory B cells differentiate quickly into plasma cells upon re-exposure to antigen.

4. **Answer: C**

Explanation: Booster doses re-activate memory B cells to strengthen and prolong the immune response.

5. **Answer: B**

Explanation: IgM is secreted first by activated plasma cells before class switching occurs.

Antigen Receptor Genetics and Somatic Mutations

1. **Answer: C**

Explanation: V(D)J recombination assembles variable region genes in developing lymphocytes within bone marrow and thymus.

2. **Answer: B**

Explanation: RAG1/2 mediates cleavage at recombination signal sequences to enable gene segment joining.

3. **Answer: C**

Explanation: Somatic hypermutation takes place in germinal centers to enhance antibody affinity after antigen stimulation.

4. **Answer: C**

Explanation: AID enzyme catalyzes cytidine deamination in switch regions, initiating recombination and isotype switching.

5. **Answer: A**

Explanation: AID deficiency results in hyper-IgM syndrome due to inability to perform class switching and somatic hypermutation.

6. **Answer: A**

Explanation: DNA ligase IV completes the recombination process by sealing DNA ends after RAG cleavage.

7. **Answer: A**

Explanation: Random addition/deletion of nucleotides at junctions increases receptor diversity.

8. **Answer: A**

Explanation: TdT randomly adds nucleotides at the V(D)J junction, enhancing antigen receptor diversity.

9. **Answer: B**

Explanation: Somatic hypermutation introduces point mutations; B cells with higher affinity are selected in germinal centers.

10. **Answer: A**

Explanation: RAG mutations prevent B- and T-cell receptor formation, leading to severe combined immunodeficiency (SCID).