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I. Medical And Veterinary Immunology, Term Test #3 – November 15, 2004

This test contains 30 total questions. You have 50 minutes to complete the test. There are two types of questions – Type I questions require the one best answer (Questions 1-25). Type II Questions (Questions 26-30) require you to chose all the relevant statements which are correct. No extra time will be provided to complete the computer answer sheet. You are to hand in this test with the answer sheet at the conclusion of the test. A complete test, with answers, will be posted next week.

Type I Questions: Mark the best answer. A, B, C, D, or E.

1. Indicate which of the following property (ies) listed below apply (ies) to T-cell receptor (TCR)
 - A. is associated with CD3
 - B. exists in membrane-bound and secreted form
 - C. is self-MHC restricted and monovalent
 - D. exhibits diversity generated by somatic hypermutation
 - E. a and c

2. T cell alloreactivity is believed to be due to
 - A. incomplete negative selection
 - B. TCR-mediated activation in the absence of co-receptor engagement
 - C. cross reaction of the TCR on a self MHC/peptide complex
 - D. recognition by the TCR of a non-self MHC/peptide complex
 - E. TCR-independent recognition due to high affinity coreceptor interaction

3. Which of the following statements regarding the $\alpha\beta$ -TCR is NOT TRUE?
 - A. The TCR is composed of an α and β chain and endodes specificity.
 - B. Addition of N- and P-nucleotides contribute to TCR diversity.
 - C. a single T cell only expresses a single TCR and this is regulated by allelic exclusion.
 - D. The TCR heterodimer can be expressed without CD3 expression.
 - E. The functional TCR is produced by rearrangement of V and J segments in α chain and V, D and J segments in the β chain.

4. Which of the following is (are) true about TCR accessory molecules?
 - A. CD4 and CD8 are important T cell accessory molecules.
 - B. They play important role in antigen recognition and T cell activation.
 - C. CD4 co-receptor binds to conserved regions of MHC class I molecules.
 - D. CD8 co-receptor binds to conserved regions of MHC class II molecules.
 - E. A and B.

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5. Which of the following molecule(s) contain(s) an ITAM motif.
- A. TCR β chains.
 - B. Ig α chains.
 - C. Membrane IgM (the μ heavy chain).
 - D. CD3 ϵ .
 - E. B and D.
6. A thymocyte is referred to as "double negative" if
- A. it lacks expression of either MHC class I or class II molecules
 - B. it has completed both positive and negative selection
 - C. it has progressed through the double positive stage and is on its way to becoming single positive
 - D. it has failed positive and negative selection
 - E. it is in an early stage in thymic development and lacks expression of CD4 and CD8 coreceptors
7. The most mature developing T cell(s) which are ready to exit thymus has/have the following phenotype(s):
- A. $\alpha\beta$ TCR $^-$ /CD3 $^-$ /CD4 $^+$ /CD8 $^+$
 - B. $\alpha\beta$ TCR $^+$ /CD3 $^+$ /CD4 $^-$ /CD8 $^-$
 - C. $\alpha\beta$ TCR $^+$ /CD3 $^+$ /CD4 $^+$ /CD8 $^+$ and $\alpha\beta$ TCR $^+$ /CD3 $^+$ /CD4 $^-$ /CD8 $^-$
 - D. $\alpha\beta$ TCR $^+$ /CD3 $^+$ /CD8 $^+$ /CD4 $^-$ and $\alpha\beta$ TCR $^+$ /CD3 $^+$ /CD8 $^-$ /CD4 $^+$
 - E. $\alpha\beta$ TCR $^+$ /CD3 $^-$ /CD4 $^+$ /CD8 $^-$ and $\alpha\beta$ TCR $^+$ /CD3 $^-$ /CD8 $^-$ /CD4 $^+$
8. Which of the following is/are TRUE
- A. Thymus is a site of T cell development and maturation.
 - B. Nude mice fail to develop thymus and show absence of circulating T cells.
 - C. The antigenic diversity of T cells is reduced during maturation in the thymus by a selection process
 - D. Positive and negative selections in the thymus result in mature T cells that are both self-MHC-restricted and self-tolerant
 - E. All of the above.
9. Two cell surface phenotypic characteristics of antigen presenting cells which are essential for their role in inducing primary CD4 $^+$ T cell responses to foreign Ag are
- A. constitutive expression of MHC class I and co-stimulatory molecule B7
 - B. high level constitutive expression of at least two different accessory molecules
 - C. constitutive expression of MHC class II and co-stimulatory molecule B7
 - D. co-expression of both MHC class I and class II molecules
 - E. constitutive expression of specific signal transducing molecule CD3 together with interleukin-2.

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10. Which of the following is/are NOT TRUE for $\gamma\delta$ -T cells.
- A. they are minor population of T cells in ruminants but a major population in mice and humans.
 - B. they lack both CD4 and CD8 molecules and are therefore referred to as double negative peripheral T cells.
 - C. In addition to blood and lymphoid tissues, they also appear in skin, intestinal epithelium and pulmonary epithelium.
 - D. they display MHC-independent binding of antigen
 - E. b, c and d
11. Which of the following is /are true about various antigen presenting cells
- A. dendritic cells can activate naïve, effector and memory T cells.
 - B. dendritic cells express both MHC class II and B7 constitutively
 - C. Resting B cells do not express B7 molecule and can not activate naïve T cells.
 - D. resting macrophages express both MHC class II and B7 constitutively and can activate naïve T cells
 - E. a, b, and c
12. Which of the following is/are NOT TRUE about T cell activation
- A. Signal 1 -interaction of TCR with MHC-peptide complex
 - B. Signal 2-antigen non-specific interaction between CD 28 on T cells and B7 molecule on APCs
 - C. T cells get fully activated upon receiving signal 1 alone.
 - D. T cells need both signal 1 and signal 2 for the full activation.
 - E. Signal 1 in the absence of signal 2 results in clonal anergy.
13. If antigen “A” is injected into an animal for the first time, which of the following would you expect?
- A. Short or no lag phase before production of antigen “A”-specific antibody starts.
 - B. Very slow decline of antigen “A”-specific antibody concentration.
 - C. Production of “A”-specific antibody predominantly of the IgG isotype.
 - D. Production of “A”-specific antibody predominantly of the IgM isotype.
 - E. All of the above.
14. A tumor cell has been isolated from the bone marrow of a patient. It is characterized as expressing μ , $\lambda 5$, $Ig\alpha$ and $Ig\beta$. What is the most likely description of the cell.
- A. a hematopoietic stem cell
 - B. a pro-B cell
 - C. a pre-B cell
 - D. an immature B cell
 - E. a plasma cell

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15. B cell anergy is best described as
- A. the process by which self-reactive B cells are deleted from the mature B cell pool
 - B. a process by which B cells are positively selected in bone marrow
 - C. an inflammatory reaction caused by the recognition of antigen by IgE
 - D. a process which involves basophils or mast cells
 - E. a process by which B cells can be rendered functionally inert
16. Antigens from sites of infection reach lymph nodes via:
- A. Afferent lymphatic vessels.
 - B. Efferent lymphatic vessels.
 - C. Lymph node arteries.
 - D. Lymph node veins.
 - E. Thoracic duct.
17. Which of the following is/are true for germinal centers
- A. germinal centers help in the generation of higher affinity B cells from B cells of lower affinity
 - B. CD40/CD40L interaction is required for formation of germinal centers
 - C. they are required for memory B cells formation
 - D. they arise within 7-10 days after initial exposure to a T-dependent antigen.
 - E. All of the above
18. Which of the following statements is/are true for the haptens?
- A. Haptens provide a means to investigate the role of T-B cell collaboration in the immune response.
 - B. haptens can generate an immune response or antibody in the presence of carrier even if it is not chemically coupled to carrier molecule
 - C. Memory cells to both hapten and carrier are required for a secondary response to hapten.
 - D. Memory T cells to the hapten and memory B cells to carrier are important in the secondary response to hapten.
 - E. A and C
19. Two key words describing cytokine biological action are pleiotropy and redundancy. Pleiotropy is best defined as:
- A. Different cytokines exert their effects in the same cells to mediate identical biological responses.
 - B. Each individual cytokine targets a single cell surface receptor to induce a unique response.
 - C. A given cytokine exhibits multiple biological activities in various target cells.
 - D. Cytokines are secreted from cells that are widespread in the body.
 - E. Cytokines that interact with the same receptor complex induce similar biological responses.

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20. Which of the following statements is/are correct?
- A. IFN- γ secreted by CD4⁺ TH1 cells is a negative regulator of CD4⁺ TH2 cells and it enhances IgG2a production by activated B cells.
 - B. IL-12 secreted by macrophages and dendritic cells enhances the T cell differentiation to TH1 phenotype.
 - C. Macrophage activation results in the secretion of specific cytokines, including IL-1, TNF- α and IL-6.
 - D. IL-4 is produced by TH1 cells and is a negative regulator for TH2 cells.
 - E. A, B and C.
21. Which of the following cytokines is/are important to effectively control the dissemination of *Mycobacterium leprae*:
- A. IFN γ
 - B. IL-4
 - C. TNF- β
 - D. IL-2
 - E. A, C and D.
22. The pluripotent hematopoietic stem cell (HSC) has the following characteristic(s):
- A. It is self-renewing and can give rise to a single type of hematopoietic cell.
 - B. It is not self-renewing and can give rise to many different types of hematopoietic cells.
 - C. It is not self-renewing and can give rise to a single type of hematopoietic cell.
 - D. It is self-renewing and can give rise to many different types of hematopoietic cells.
 - E. It is the main source of hemoglobin in the organism.
23. Cytotoxic T cells (CTLs) kill their targets by following mechanism (s)
- A. Perforins and granzymes
 - B. Fas mediated cytotoxicity
 - C. Complement activation
 - D. A and B
 - E. A and C
24. Which of the following is/are true for cytotoxic T cell (CTL)
- A. Naïve cytotoxic T cells are capable of killing target cells
 - B. Naïve cytotoxic T cells express IL-2 R and produce IL-2.
 - C. IL-2 is required for the proliferation and differentiation of CTL-Ps to effector CTLs.
 - D. Activated effector CTLs do not require signal 2 or IL-2 to kill target cells.
 - E. C and D.

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25. Which of the following is/are NOT TRUE for Antibody-dependent cell mediated cytotoxicity (ADCC)

- A. is dependent of Fc receptors on the surface of cytotoxic cells
- B. is characteristic of eosinophils, macrophages, NK cells and neutrophils.
- C. specificity of the antibody directs the effectors cells to specific targets.
- D. involves complement mediated lysis.
- E. important in killing virus infected cells and helminthes

Type II Questions:

For each of the following questions, mark

A if 1, and 3 are correct

B if 2 and 3 are correct

C if 1, 2, and 3 are correct

D if 4 is correct

E if 5 is correct.

26. Positive selection

- 1. is responsible for induction of non-reactivity of developing $\alpha\beta$ -T cells to self MHC and self antigens
- 2. refers to the process by which thymocytes expressing $\alpha\beta$ -TCRs which are able to interact with self-MHC/peptide complexes on thymic epithelial cells continue maturation in the thymus
- 3. is responsible for the finding that T cells recognize foreign antigens only in association with self MHC
- 4. is the mechanism by which peptides of an appropriate size are selected for presentation by self MHC molecules
- 5. refers to the process by which thymocytes bearing TCRs which do not recognize self MHC are retained in the thymus

27. Superantigens

- 1. bypass normal immune recognition requirement
- 2. are viral or bacterial proteins that simultaneously bind to $v\beta$ domain of a TCR and to the α chain of class II MHC molecule and induce polyclonal activation of T cells
- 3. result in the overproduction of TH-cell cytokines and cause systemic toxicity.
- 4. contain peptides that can displace the other peptides in the peptide binding cleft of MHC class II molecules
- 5. are very efficient at inducing immune responses which are specific for the superantigen only.

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28. B-1 cells:

1. produce high affinity antibodies
2. make antibody to polysaccharide antigens but respond poorly to protein antigens
3. major cell type found in the peritoneum
4. produce mainly IgG
5. frequently undergo somatic hypermutation and class switching

29. With regard to IL-2, which of the following statements is/are correct?

1. A genetic defect associated with IL-2R γ deficiency/truncation, results in a X-linked severe combined immunodeficiency syndrome, XSCID.
2. IL-2 receptor occurs in three forms and exhibit different specificities for IL-2.
3. IL-2R β and IL-2R γ subunits are expressed constitutively on resting T cells and NK cells and a high affinity IL-2R complex with IL-2R α , - β and - γ subunits is expressed on activated CD4⁺ and CD8⁺ T cells and activated B cells.
4. A genetic defect associated with IL-2R γ deficiency, results in a X-linked hyper-IgM syndrome.
5. IL-2 is not required for the activation and differentiation of T cells.

30. Natural killer cells (NK cells)

1. NK activity is stimulated by IFN- α , IFN- β and IL-12
2. All NK cells express CD 16 (Fc γ IIIIR).
3. Non-specifically kill tumor and virally infected cells.
4. They do not contain perforin.
5. NK- cell response generates immunologic memory.