MCMP 422
Final Exam
2005
STUDY GUIDE
Chapters 1-7
Harrison

The best way to study for Dr. Harrison's section of the final exam (Chapters 1-7) is to study previous tests from this year, your notes and understand the figures in the book. If your notes are not thorough or you do not understand your notes or a particular figure we went over in class, then read the appropriate section of the book. If you have time, reading the book is a plus.

CHAPTER 1 (Lectures 1-3)

1. Tissues, cells and blood proteins (e.g., complement) of the Immune System (IS)
   -know who are phagogcytes, APCs, killer cells (both CD8 and NK cells), helper cells (Th1 and Th2)
2. Innate and Adaptive Immunity
   -know cells and characteristics of each (remember processes involving T or B cells or antibodies or cytokines secreted by T or B cells are part of the adaptive IS)
3. Know receptors for antigen (BCRs and TCRs)
   -identical on a single cell, different on different cells
   -know the structure of the antigen bound by the TCR and bound by the BCR
4. Understand clonal selection
5. Basis of vaccination: understand why a secondary response (memory response) is not made to vaccine B in Fig. 1.26

CHAPTER 2 (lectures 4-6)

1. Structure of Igs (Abs), complementarity determining regions (CDRs)
2. Generation of diversity in the IS (when, who, where and how)
3. Ig gene rearrangement
4. Ig diversity BEFORE antigen encounter: 1) random combination of V and J (light chain) and V, D, J (heavy chain) gene segments; 2) junctional diversity; 3) combinatorial association of heavy and light chains
5. Ig diversity AFTER antigen encounter: somatic hypermutation followed by affinity maturation
6. Isotype switching and function of individual Ig (Ab) isotypes

CHAPTER 3 (lectures 7-10)

1. TCR: structure, generated by random recombination
2. Antigen processing and presentation
   -MHC I and MHC II
   -extracellular versus intracellular pathogens
   -remember most MHC I and MHC II bind self peptides
   -superantigens

3. MHC I and MHC II
   -polymorphic (many different alleles in the human race)
   -polygenic (3 genes encode MHC I, 3 genes encode MHC II α chain and at least 3 genes encode MHC II β chain)
   -expression of MHC is co-dominant (all genes of a given class (i.e., class I or class II) are expressed simultaneously on a single cell)

CHAPTER 4 (lectures 11-12)

1. 4 Stages of B cell development (development in the bone marrow, elimination of self reactive B cells, activation by Ag and differentiation into plasma cells)
2. B cell development is characterized by different Ig gene rearrangements: stem cell, pro B cell, pre B cell, immature B cell, mature B cell)
3. Heavy chain rearranges first, surrogate light chain, then light chain rearranges (have two tries at the kappa (κ) locus, if fails, two tries at the lambda (λ) locus)
4. role of bone marrow stromal cells
5. most developing B cells die: 1) fail to productively rearrange DNA, clonal deletion (recognize self antigens)
6. mature B cells need survival signals from follicular dendritic cells (FDCs) (too many B cells, not enough FDCs)
7. Germinal Centers: centroblasts, centrocytes, lymphoblasts, memory B cells, plasma cells)

CHAPTER 5 (lectures 13 and 14)

1. T cell development in the thymus
   -α,β T cells: β rearranges first (4 tries), surrogate α chain (pre T α receptor), then α rearranges (several tries)
2. Positive selection
   -happens first
   -double positive cells undergo positive selection
   -occurs in cortex of the thymus; MHC on cortical epithelial cells test developing T cells
   -selected to recognize self MHCs (engaging TCR is a signal to LIVE), no TCR engagement the cell dies
3. negative selection
   -happens after positive selection
   -double positive cells that are committed to a single lineage (either CD4 or CD8) undergo negative selection
   -occurs at cortical-medullary junction, self Ag is presented by bone marrow derived dendritic cells and macrophages (APCs)
   -selected NOT to recognize self antigen (strongly engaging TCR is a signal to DIE), no TCR engagement the cell lives
4. Unlike B cells, T cells are long lived

CHAPTER 6 (lectures 15-17)

1. T-cell activation (Priming)
   -first encounter with antigen (APCs)

-secondary lymphoid tissue
-pathogen arrives by lymph, dendritic cells at wound site engulf pathogen and then migrate to secondary lymphoid tissues
-T cells encounter antigen undergo clonal selection
-primed CD8 and Th1 cells leave secondary lymphoid tissues (Th2 stay)

2. Co-stimulation
-CD28 on T cell, B7 on APC (constitutive on MATURE dendritic cells, induced by activation on macs and B cells)
-needed by naïve T cells, not needed by primed T cells
3. TCR engagement and co-stimulation triggers signaling pathway leading to gene transcription (especially Interleukin 2 (IL-2)
4. Cyclosporin A, tacrolimus (FK506) inhibits IL-2 production
5. Anergic T cells (naïve T cells stimulated in the absence of CD28)
6. Function of effector Th1
7. Function of effector Th2
8. Function of effector CD8
9. *Mycobacterium leprae*: Th1 response, patient lives; Th2 response patient dies
10. Only dendritic cells can directly activate CD8 cells (need stronger co-stimulation)
11. Function of IL-2, Il-3, GMCSF, IL-7, IL-4, IL-5, IL-6, IFN-γ, TNF-α, TNF-β, CD40 and CD40L (ligand), IL-10, IL-13

CHAPTER 7 (lectures 18-21)

1. Antibody Production by B Cells
-TI (thumus independent) antigens
-Effector CD4 Th2 cells help B cells in the "T cell area" of the secondary lymphoid tissues
-Effector Th2 cells secrete IL-4, which causes B cells to divide
-Somatic hypermutation, affinity maturation, isotype switching
2. Functions of Abs (Fab region, Fc region)
3. Function of IgM, IgG, IgA, IgE
4. Neutralizing Abs (immobilize toxins and pathogens)
5. Abs as opsonins (macs and neutrophils express receptors for Fcγ, mast cells, basophils and eosinophils have receptors for Fcε)
6. complement
-part of the innate immune system in absence of Ig
-part of adaptive IS when fixed by IgM or IgG (bind C1q)
-C3b is the key
-macs and neutrophils have receptors for C3b
-facilitates engulfment of encapsulated bacteria
-used by rbcs to remove Ag:Ab complexes
-mediates inflammation
-causes direct lysis of bacteria