

GMS 6006 - Fundamentals of Immunology & Microbiology
Spring 2008 midterm exam questions from Dr. McCormack

1. (30 points) Deion is an irritable 6 month-old male infant referred to Shands Hospital. He has a history of runny nose, persistent dry coughs, recurrent ear infections (successfully treated with amoxicillin) and diaper rash. Last month he had pneumonia in both lungs, which was treated with clarithromycin. Although of normal weight at birth, he has not been gaining weight normally and is now in the 15th percentile. His pediatrician administered polio and diphtheria-pertussis-tetanus (DPT) vaccines at ages 4 and 5 months.

(A) What kinds of pathogens are infecting Deion? (3 points)

Mostly bacterial (they were treated successfully with antibiotics), may be some fungal also (diaper rash)

(B) What cellular “space” is invaded by these infectious agents? (3 points)

Extracellular

(C) What effector mechanism is the most effective against these kinds of pathogens? (3 points)

Antibody (and complement)

Upon exam, Deion’s tonsils were observed to be small. Cultures from the clear discharge from his nose grew *Pseudomonas aeruginosa*. His white blood count was 4,800 cells/ul (the normal range is 5,000-10,000 cells/ul). None of Deion’s circulating white blood cells expressed CD3, and 99% of them were CD20-positive (a B cell marker). His blood mononuclear cells were completely unresponsive in culture to mitogens (substances that cause antigen-independent polyclonal proliferation), and were also unresponsive to specific antigens to which he had been exposed by immunization or infection, *i.e.*, tetanus & diphtheria toxoids. His serum immunoglobulin levels are shown below.

	Serum immunoglobulin (mg/dl)	
	Deion	Normal control
IgG	30	600-1400
IgA	19	60-380
IgM	42	40-345

(D) Deion’s diagnosis is severe combined immunodeficiency. Explain briefly in terms of B and T cell number and function, why is it “severe” and why is it “combined”. (4 points)

T cells are absent; B cells are present in near normal numbers.

No T cell function (helper T cells or CTL); B cells function poorly because no T cell help. Severe because all adaptive immunity effector functions; Combined because affects B and T cells.

1. (E) A biopsy of Deion's thymus revealed the presence of "double-positive" cells, but no "single-positive" cells. Briefly define two critical steps in lymphocyte development that must be blocked in Deion's thymus. (4 points)

Positive selection - survival of DP T cells that recognize self- MHC

Negative selection - elimination of DP T cells that recognize self-antigen

Random inactivation of CD 4 or CD8

(F) Why does Deion have a lot of B cells, but no functional immunity? (4 points)

Without T helper cells, B cells cannot function normally

(G) Deion was treated with intravenous gamma-globulin infusions to maintain a blood level of 600 mg/dl. Does this provide passive or active immunity? (3 points)

Passive

(H) Deion was further treated by bone marrow transplantation using his mother as the donor. The bone marrow from his mother was depleted of mature T cells by treatment with anti-CD3 plus complement. Sixty days later, Deion's blood contained 1,000 maternal CD3-positive T cells/ul, which responded to mitogens. His immune system was slowly reconstituted over the next 3 months. Why was it necessary to treat the donor bone marrow to remove mature T cells before the transplant? (3 points)

Mature maternal T cells would recognize Deion's cells as foreign and cause graft-versus-host reaction

(I) Immunodeficient patients such as Deion should NEVER be given live virus vaccines (*e.g.*, polio). Why not? What are the risks? (3 points)

Live virus vaccines work by establishing an active infection that does not cause overt disease, but stimulates an immune response. In an immunodeficient patient disease could result from the live virus. Even worse, attenuated viruses sometimes mutate or revert to a "wild-type" or infectious phenotype. Such viruses would not be controlled in an immunodeficient patient.