Immune Responses

A. Innate Defenses (Nonspecific Defenses)

1. Inherited defenses

2. Attempt to stop all foreign invaders in the same way (nonspecific)

3. Broken down into different categories

A) Mechanical protection

1) Epidermis

2) Mucus

3) Cilia/hair

4) Lacrimal apparatus

5) Saliva

6) Urination & defecation

7) Vomiting & diarrhea

B) Chemical protection

1) Lysozymes – destroy bacteria; found in perspiration, lacrimal fluid, sebum, and

saliva

2) Gastric juice, vaginal secretions, urine, bile, and pancreatic juice – alter pH

C) Interferons

1) Work by inhibiting viral replication in cells

2) Released from:

a) Virus-infected cells

b) Lymphocytes & macrophages

D) Natural Killer cells (NK cells)

1) Present in spleen, lymph nodes, red bone marrow, and blood

2) Attack foreign cells, virus-infected cells and tumor cells in healthy tissue

E) Phagocytosis

1) Neutrophils

2) Macrophages (monocytes) – 2 types

a) Wandering

b) Fixed

3) Steps of Phagocytosis

a) Leukocytosis

b) Margination

c) Diapedisis

d) Chemotaxis

e) Adherence/opsonization

f) Ingestion

i) Phagosome

g) Phagolysosome formation

i) Lysosome – vesicle containing:

(a) Lysozymes

(b) Digestive enzymes

h) Digestion

i) Residual bodies

i) Exocytosis

F) Inflammation – 3 stages

1) Increased vasodilation & permeability

a) Causes characteristic warmth, redness, pain & swelling

b) Aided by a number of chemicals (in response to tissue damage)

i) Histamine – released by many blood cells

ii) Kinins – formed in blood

(a) Also a chemoattractant (attracts phagocytic WBC)

iii) Prostaglandins – released from damaged cells

(a) Intensify effects of histamine and kinins

(b) May promote diapedisis

iv) Leukotrienes – released by basophils & mast cells

(a) Promote adherence

2) Phagocyte mobilization

3) Tissue repair

G) Fever

1) Caused by pyrogens

a) Any chemical that causes an increase in body temperature

b) Most often released from WBC, as well as some bacteria

2) Promote sequestration of iron & zinc

3) May aid interferon, inhibit microbe growth, & speed reaction time of defense

cells

H) Complement System

1) A group of at least 20 plasma proteins

2) Once activated some increase the inflammatory response while others destroy

bacteria directly

B. Adaptive Immunity (Specific Defense)

1. 3 important aspects

A) Antigen-specific

1) Antigen – any substance that initiates an immune response

B) Systemic

C) Has memory

2. 2 types of adaptive immunity

A) Cell-mediated immune response

B) Antibody-mediated (humoral) immune response

3. Overview of Cell-Mediated Immunity

A) An antigen penetrates body’s nonspecific defenses

B) Antigen is taken up by an antigen-presenting cell (APC) and broken down

C) Antigen fragments merge with major histocompatability complex (MHC) proteins

on the APC’s membrane

1) MHC – special proteins imbedded in a cell’s membrane; allows for the

recognition of self by the B & T cells

D) Inactive T cells comes into contact with APC, recognizes the altered MHC protein,

and becomes active

E) Activated T cells divide and differentiate

1) Cytotoxic T cells (CD8 cells)

a) Rupture the antigen’s cell wall/membrane

b) Secrete a lymphotoxin into the antigen

c) Alter the antigen’s DNA causing cell death

2) Memory T cells

a) Recognize antigens directly (sometimes by their MHC proteins) to speed

future responses

3) Suppressor T cells

a) Suppress the cytotoxic T cells when their job is complete

4) Helper T cells (CD4 cells)

a) Produce a number of interleukins (IL’s)

i) IL-2 – stimulates T cell proliferation

ii) IL-4 – promotes T cell growth; stimulates production of IgE

iii) IL-5 – promotes the secretion of IgA

4. Overview of Antibody-Mediated Immunity

A) Cell-mediated response has occurred

B) Helper T cells activate previously inactive B cells

1) Stimulate B cell division & differentiation

a) Memory B cells

b) Plasma cells

C) Antibody merges w/ antigen = antigen-antibody complex

D) Antibody causes destruction of the antigen

1) Neutralization

a) Bind to toxins or virus rendering them useless

2) Immobilization

a) Bind to cilia or flagella slowing antigen movement

3) Attraction of phagocytes

4) Facilitating phagocytosis

5) Stimulating inflammation

6) Inhibiting antigen metabolism

5. Antibody Structure

A) Consist of 4 polypeptide chains

1) 2 identical chains ~450 amino acids in length known as heavy (H) chains

2) 2 identical chains ~220 amino acids in length known as light (L) chains

B) The H chain has 5 variations resulting in 5 classes of antibodies (immunoglobulins)

1) IgA – found in blood plasma, breast milk, and mucus membranes

a) Prevents pathogens from adhering to epithelia and penetrating tissues

2) IgD – integral part of B cell membrane

a) Acts as an antigen presenter

3) IgE – found mainly in tonsils, skin & mucus membranes

a) Stimulates mast cells & basophils to release contents and attracts eosinophils

4) IgG – 75-85% of circulating antibodies in plasma

a) Crosses placenta to confer temporary immunity to the fetus

5) IgM – found on the B cell membrane and circulating in plasma

a) Presence indicates a recent infection