

Immune System

Function, Assessment & Therapeutic Measures

Chapter 17

Normal anatomy & physiology

- Immunity
 - Ability to destroy pathogens/foreign material
 - Microorganisms
 - Bacteria
 - Viruses
 - Fungi
 - Other cells/substances
 - Malignant cells
 - Transplanted organs
 - Own body (autoimmune disease)

Normal anatomy & physiology

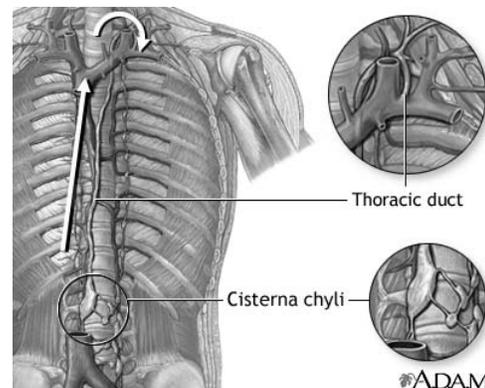
- Immune system
 - Lymphoid organs
 - Lymphocytes & other WBCs
 - Other chemicals
 - Activate our own cells
 - To destroy foreign antigens

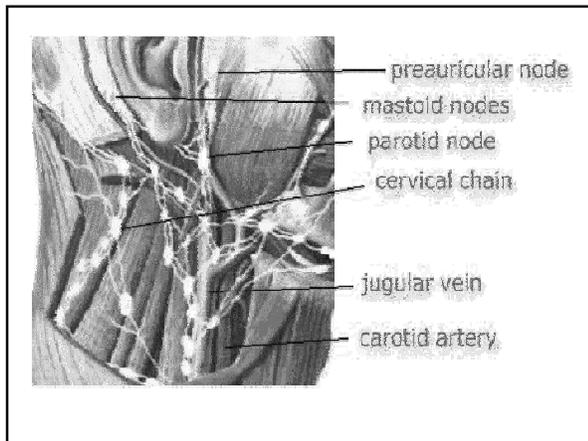
Lymphatic System

- Complex system of fluid drainage and transport
- Provides immune response
- Disease resistance
- Fluid forced out of bloodstream during normal circulation
- Bathes cells in nutrient rich plasma (O₂, protein, glucose, and WBC's)
- Clear fluid
- RBC's too large to pass through capillaries

Lymphatic System

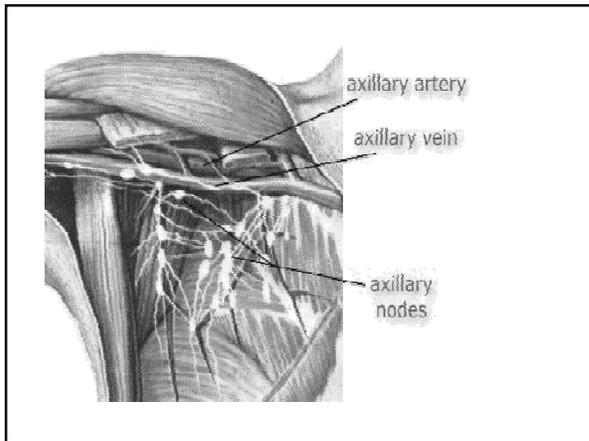
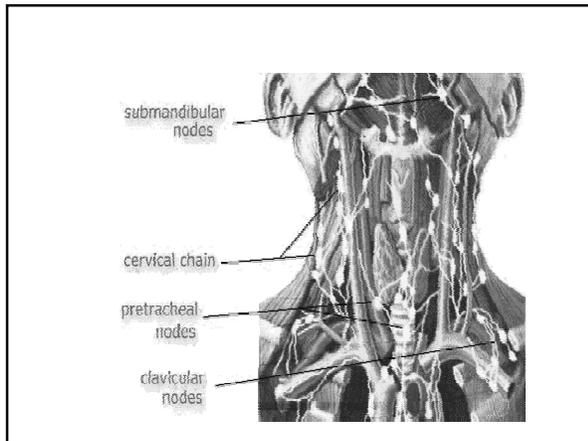
- Recirculated back into the bloodstream via the lymph vessels
- Lymph capillaries pick up the lymph fluid
- Pass into lymph vessels and progress through lymphatic vessels
- Similar to veins—one-way valve and muscle motion pumps the lymph
- Moves in one direction—towards the heart
 - No pumping action
 - More valves than veins
 - Thinner walls and larger lumen than veins





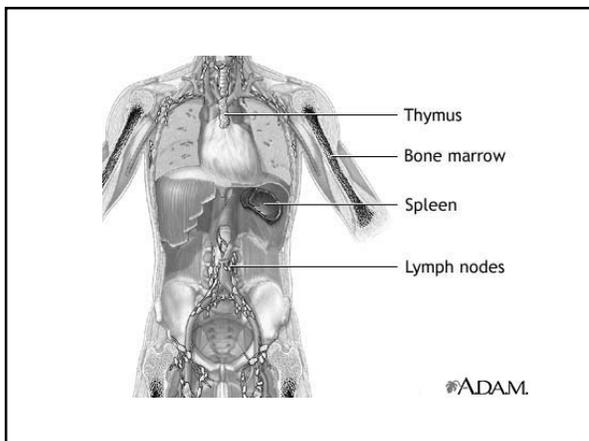
Lymphatic System

- Lymph in the lymph vessels passes through lymph nodes
- Lymph nodes
 - Filter the lymph
 - Contain large numbers of WBC's
 - Macrophages remove foreign cells and debris
 - Lymphocytes are added to the lymph
 - Filtered lymph is cleaner than when entered node



Lymphatic System

- Thymus
 - Functions primarily in childhood
 - Shrinks before adulthood
 - T cells mature in thymus
- Spleen
 - Produces WBC's—lymphocytes and monocytes
 - Produces antibodies
 - Phagocytizes pathogens or other foreign material
 - Phagocytizes old RBC's—form billirubin

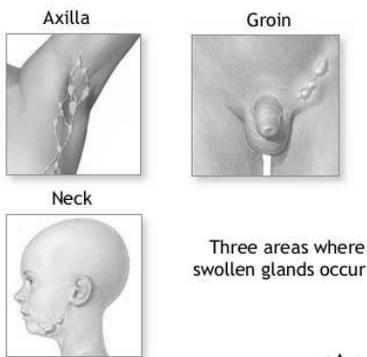


Lymphatic System

- Lymph nodules
 - Small masses of lymphatic tissue
 - Scattered throughout loose connective tissue
 - Respiratory tract--tonsils
 - Intestines—Peyer's patches
 - Urinary tract
- Strategically placed to defend against organisms entering from outside body
- Lymph nodules are not connected to lymph system with lymph flowing through them

Lymphatic System

- Lymph nodes
 - Strategic positioned throughout the body
 - Lymph passes through a number of nodes before returning to blood supply—approximately 8 to 10
 - Nodes vary in size
 - Pin head
 - Almond
- Connected to lymph vessels
- Three major groups
 - Cervical
 - Axillary
 - Inguinal



Antigens

- Chemical markers
 - Identify molecules & cells
 - Examples of molecules
 - Bacterial toxin
 - Plant pollens or proteins
 - Protein products of viral cellular activity
 - Examples of cells
 - Major histocompatibility complex (MHC)
 - Aka; human leukocyte antigens (HLAs)

Leukocytes

- Leukocytes—White blood cells
 - Granulocytes—50 to 60% of all leukocytes
 - Lymphocytes—30 to 40% of all leukocytes
 - Monocytes—7% of all leukocytes
- Granulocytes—have granules that release chemicals
 - Neutrophils
 - Eosinophils
 - Basophils
- Agranulocytes—no granules
 - Lymphocytes
 - Monocytes

Leukocytes

- Neutrophils
 - Produced in bone marrow
 - Released in response to bacterial infection and inflammation
 - Most common of WBC's
 - Short life span—one day
 - Neutrophils engulf foreign antigen—release chemicals
 - Dead neutrophils and cellular debris form pus at site
- Neutrophil count increases with bacterial infections and inflammation

Leukocytes

- Eosinophils
 - Focus on parasites in skin and lungs
 - Allergies
- Basophils
 - Carry histamine

Lymphocytes

- 30 to 40% of all leukocytes
- Increase in viral infections
 - T cells
 - B cells
 - Natural killer cells
- Lymphocytes are found in the bloodstream but concentrate in lymph tissue
 - Lymph nodes
 - Thymus
 - Spleen

Lymphocytes

- Natural killer cells
 - Found in blood, bone marrow, lymph nodes & spleen
 - Ability to destroy many pathogens & tumor cells
 - Considered nonspecific resistant mechanism
 - Since effective against variety of foreign antigens

T Cells & B Cells

- Each cell involved in specific immune responses
 - Responds to one kind of foreign antigen
- Develop in bone marrow (fetal)
 - T cells migrate to & mature in thymus
 - Then migrate to lymph nodes/nodules/spleen
 - B cells mature in bone marrow
 - Migrate to lymphatic tissue
 - Differentiate
 - Plasma B cells
 - Memory B cells

Monocytes

- 7% of all leukocytes
- Released from bone marrow
- Enter bloodstream
- Enter tissue
- Become macrophages
- Most tissue has designated macrophages
 - Langerhans

Monocytes

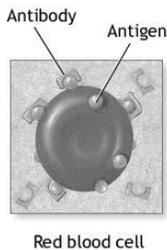
- Primary function---to keep their designated area clean
- Free flowing macrophages—clean up dead neutrophils and other foreign bodies they meet along the way

Antibodies

- Aka; immunoglobulins (Ig) or gamma globulins
- proteins produced by plasma cells
 - When exposed to foreign antigens
- Attach to antigens
 - Label them for destruction
- Many different types
 - Specific for only one antigen

Antibodies

- Five classes
 - IgM
 - IgG
 - IgA
 - IgE
 - IgD



An antibody is a protein produced by the immune system in response to the presence of an antigen

Red blood cell

©ADAM.

Immunoglobulins

- IgM
 - Largest type of antibody
 - Found in blood and lymph fluid
 - First responder—first type of antibody produced in response to an antigen
- IgG
 - Found in all body fluids
 - Smallest but most abundant
 - Considered most important antibodies for fighting bacterial and viral infections
 - Only antibody that can cross the placenta

Immunoglobulins

- IgA
 - Mainly found in areas of the body exposed to the outside
 - Nose, respiratory tract, digestive tract, ears, eyes, and vagina
 - Also found in saliva and tears
 - A small percentage of people do not make IgA antibodies
- IgE
 - Found in lungs, skin, and mucous membranes
 - Cause the body to react against foreign substances such as pollen, fungus spores, and animal dander
 - IgE antibody levels are often high in people with allergies

Immunoglobulins

- IgD
 - Function not well understood
 - Found in small amounts in the tissues that line in the abdominal or chest cavity of the body
- The levels of each type of antibody can give information about the medical problem

Nonspecific Immunity

- Protects the body against many different types of foreign agents
- The body does not need to recognize the specific foreign agent
- Nonspecific immunity lines of defense
 - First line
 - Second line
 - Third line

Nonspecific Immunity

- First line
 - Mechanical defense
 - » Skin
 - » Mucus membranes
 - Chemical barriers
 - » Tears
 - » Saliva
 - » Perspiration
 - » Stomach acid
 - » Digestive enzymes

Nonspecific Immunity

- First line
 - Reflexes
- Second line
 - Phagocytosis
 - Inflammation
 - Fever
 - Protective proteins
 - Natural killer cells
- Third line
 - Specific immunity

Two mechanisms of Specific Immunity

1. Cell-mediated immunity
 - Involves T cells
 2. Humoral immunity
 - Involves both T and B cells
- Invasion of pathogen activates both

Two mechanisms of Immunity (cont.)

- Recognition of foreign antigen
 - 1st step of destruction
 - B cells in lymphatic tissue recognize antigen
 - Become activated B cells
 - Activation is enhanced
 - If foreign antigen presented by dendritic cells
 - Helper T cells (CD4)
 - Also recognize foreign antigens
 - Provide further stimulation of B cells
 - causing B cell proliferation (division) and differentiation (become more specialized)
 - Macrophages or other antigen-processing cells
 - Also present foreign antigens
 - Present own MHC antigens to T cell for comparison

Cell-mediated Immunity

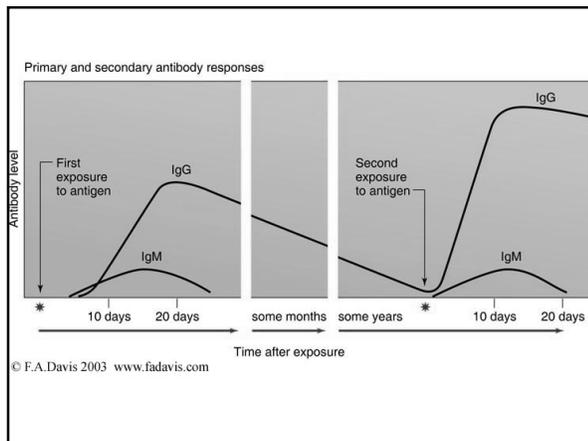
- Does not involve the production of antibodies
- Effective against intracellular pathogens
 - Viruses, fungi, malignant cells, grafts
- Recognition of foreign antigen 1st step
 - By helper T cells and macrophages
- Activated T cells divide many times
 - Become more specialized
 - Cytotoxic or killer T cells (DC8)
 - Memory T cells
 - Suppressor T cells

Humoral Immunity

- Aka; antibody-mediated immunity
 - Involves antibody production
- Recognition of foreign antigen 1st step
 - By B cells
 - After recognition
 - Some B cells become antibodies
 - Some B cells become memory B cells
- Antigen-antibody complex
 - By opsonization
 - Stimulates complement fixation
 - Group of 20 plasma proteins

Antibody Responses

- 1st exposure to foreign antigen
 - Stimulates antibody production
 - Very slow/small amounts
 - To late to prevent disease
- Subsequent exposures
 - Memory cells initiate rapid response
 - Large amounts antibody
 - Prevents a second case of illness



Antibody Responses (cont.)

- Neutralizes viruses
 - Attack and render it unable to enter a cell
- Interferon
 - Chemical produced by cells infected by viruses
 - Does not kill infected cell
 - Protects surrounding cells
 - Allowing cell ability to resist viral replication
 - Limiting/slowing viral growth

Antibody Response in Allergic Reactions

- Harmless antigen (allergen)
 - Immune system responds
 - IgE antibodies bond to mast cells
 - Causing break down/release histamine & other chemicals
 - » Contribute to inflammation
 - Anaphylactic shock
 - Massive allergic reaction
 - Profound loss of plasma from capillaries
 - Caused by histamine
 - Sudden drop of intravascular blood volume
 - Profound hypotension

Types of Immunity

- Passive immunity
 - Antibodies obtained from another source
 - Mother to fetus
 - Artificially acquired
 - Involves injection of pre-formed antibodies
 - ie; tetanus immunoglobulins
- Active immunity
 - Individual produces own antibodies
 - Recovery from disease
 - Artificially acquired
 - Vaccine
 - Stimulates antibody and memory cell production

Aging & Immune System

- Efficiency decreases
 - More susceptible to infections
- Autoimmune diseases more common
 - Immune system malfunctions
 - Mistakenly sees own body as foreign
 - Initiates tissue destruction against self
- Higher incidence of cancer
 - Unable to destroy malignant cells as effectively

Aging & Immune System

- Immune senescence changes
 - Decrease thymus gland size
 - Increased production of immature T cells
 - Decline response to antigens
 - Decrease antibody response to diseases
 - Pneumococcus
 - Influenza
 - Tetanus

Aging & Immune System

- Recommended vaccines for elderly
 - Diphtheria tetanus booster q10yrs
 - Pneumovax
 - Provides lifetime immunity
 - Influenza yearly before flu season
 - Hepatitis B vaccine
 - Medium to high risk pts

Immune System Assessment

- Nursing assessment
 - Subjective data
 - Demographic data
 - History
 - Cultural considerations
 - Current problem
 - Objective data



Diagnostic Tests

Blood tests

- Screening tests – initially
 - Refer to Table 17.4
 - If abnormal
 - Specific tests may be ordered
 - To precisely identify disorder
 - » Refer to Table 17.4

Diagnostic Tests

Radiographic Tests

- Used to identify size & density of structures or abnormal growths
 - Chest x-ray (CXR)
 - Magnetic resonance imaging (MRI)
 - Computed tomography (CT)

Diagnostic Tests

Biopsies

- Confirm diagnosis
- Determine prognosis
- Evaluate treatment
- Examples
 - Lymph nodes
 - Organs
 - Bone marrow aspirations

Diagnostic Tests

Skin Tests

- Uses
 - Infectious disease
 - Candida, tetanus, or Tb (PPD)
 - Identify an allergen
 - Drug or food allergy
 - Allergic rhinitis

Diagnostic Tests

Gene Tests

- Process of mapping the human genome
 - Allows gene testing/manipulation
 - Tests for
 - Numerous diseases
 - Predisposition to diseases
 - Enzyme deficiencies

Therapeutic Measures

Allergies

- Medical alert bracelet
- Epinephrine pen
 - Drug of choice for anaphylactic rx
 - Time is crucial – give ASAP
- Anaphylactic kit
 - Injectable epi
 - Oral chewable antihistamine tablets
 - Tourniquet
 - Instructions for use

Therapeutic Measures

Immunotherapy

- Desensitizes pts w/anaphylactic rxs
- Small amounts of an extract of the allergen is injected
 - Amt increased slowly
 - Until desired hyposensitivity reached
 - Initially shots given weekly or biweekly
 - Then q few weeks indefinitely for years
 - Anaphylaxis can occur anytime
 - MD/emergency equipment readily available
 - Observe pt for ~ 20-30" before release

Therapeutic Measures Medications

- Epinephrine
- Corticosteroids
- Antihistamine
- Decongestants
- Mast-cell stabilizing drugs
- Antivirals
- Antibiotics
- Immunosuppressants
- Interferon
- Leukotriene antagonist
- Hormone therapy

Therapeutic Measures Surgery/New therapies

- Splenectomy
 - May be necessary to control symptoms
- Monoclonal antibody
 - Cloning of specific antibody and growing unlimited amounts
 - Used for transplant rejections
- Recombinant DNA
 - Combines genes from one organism w/genes of another
- Stem cell research
 - Stem cells injected into abnormal areas to produce normal cells