Immune System

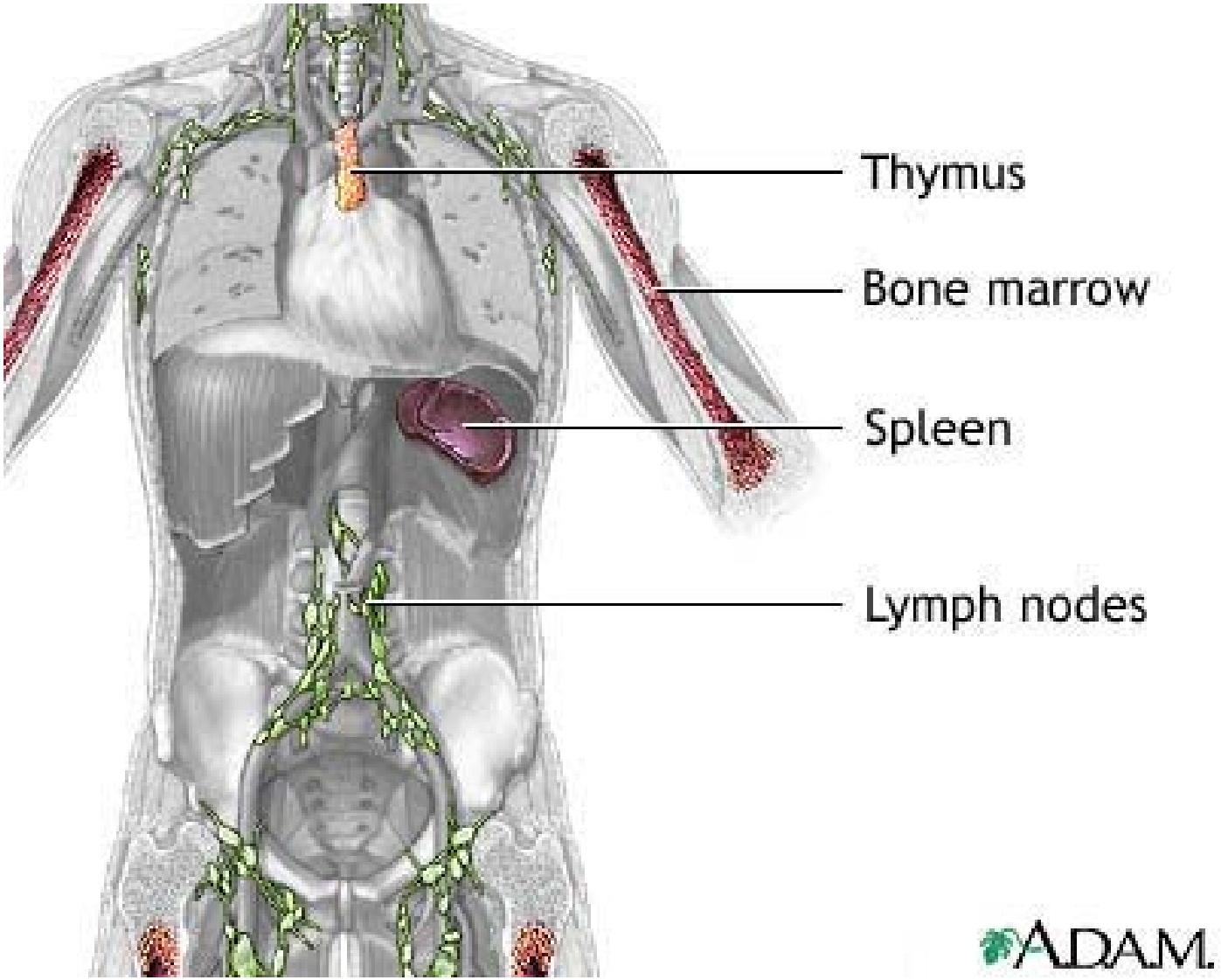
Function, Assessment & Therapeutic Measures

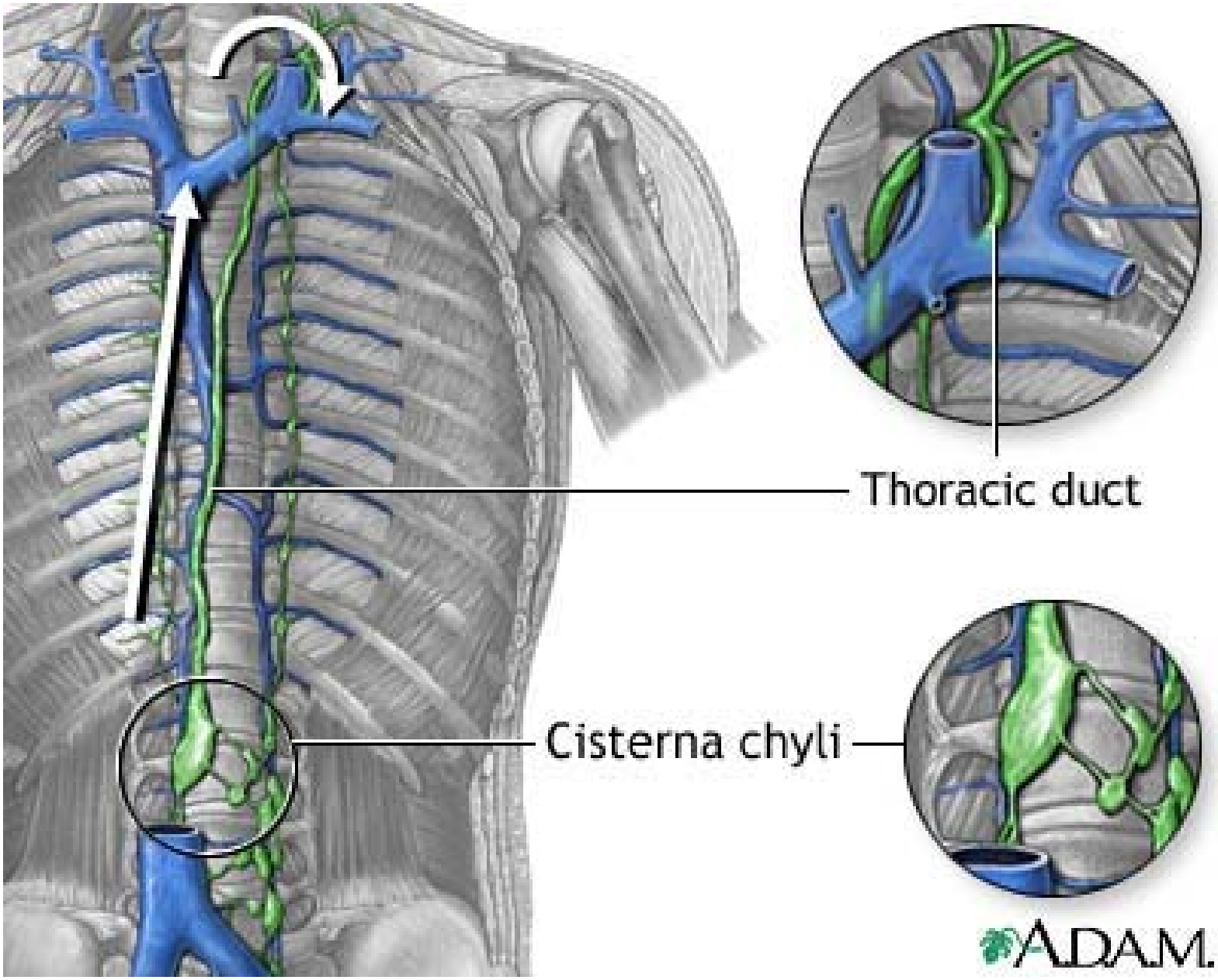
Normal anatomy & physiology

- 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

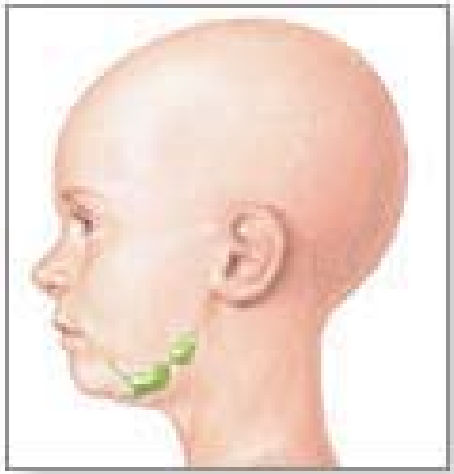

Thymus
Bone marrow
Spleen
Lymph nodes
A.D.A.M.


Thoracic duct
Cisterna chyli
A.D.A.M.

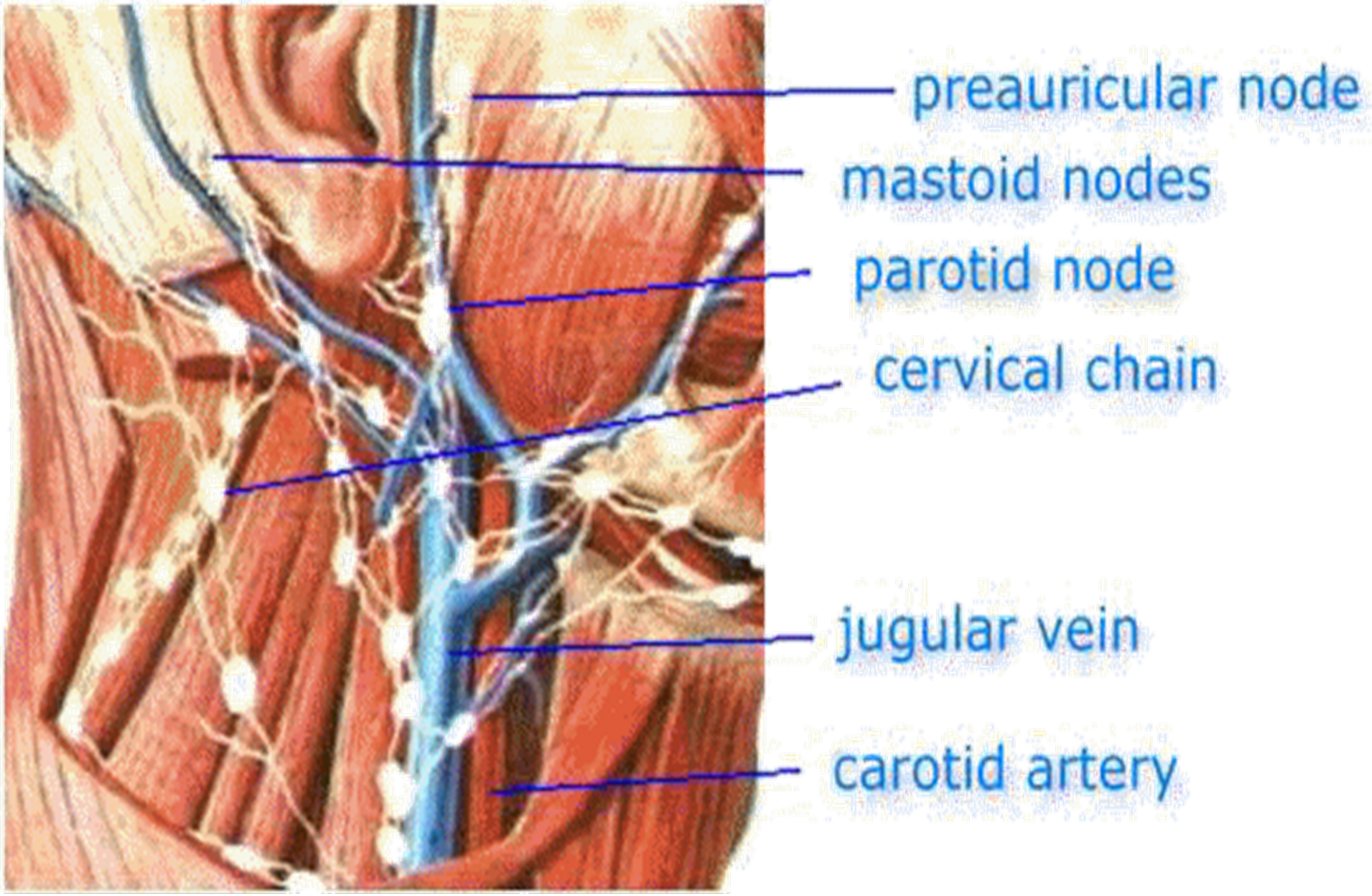
Axilla

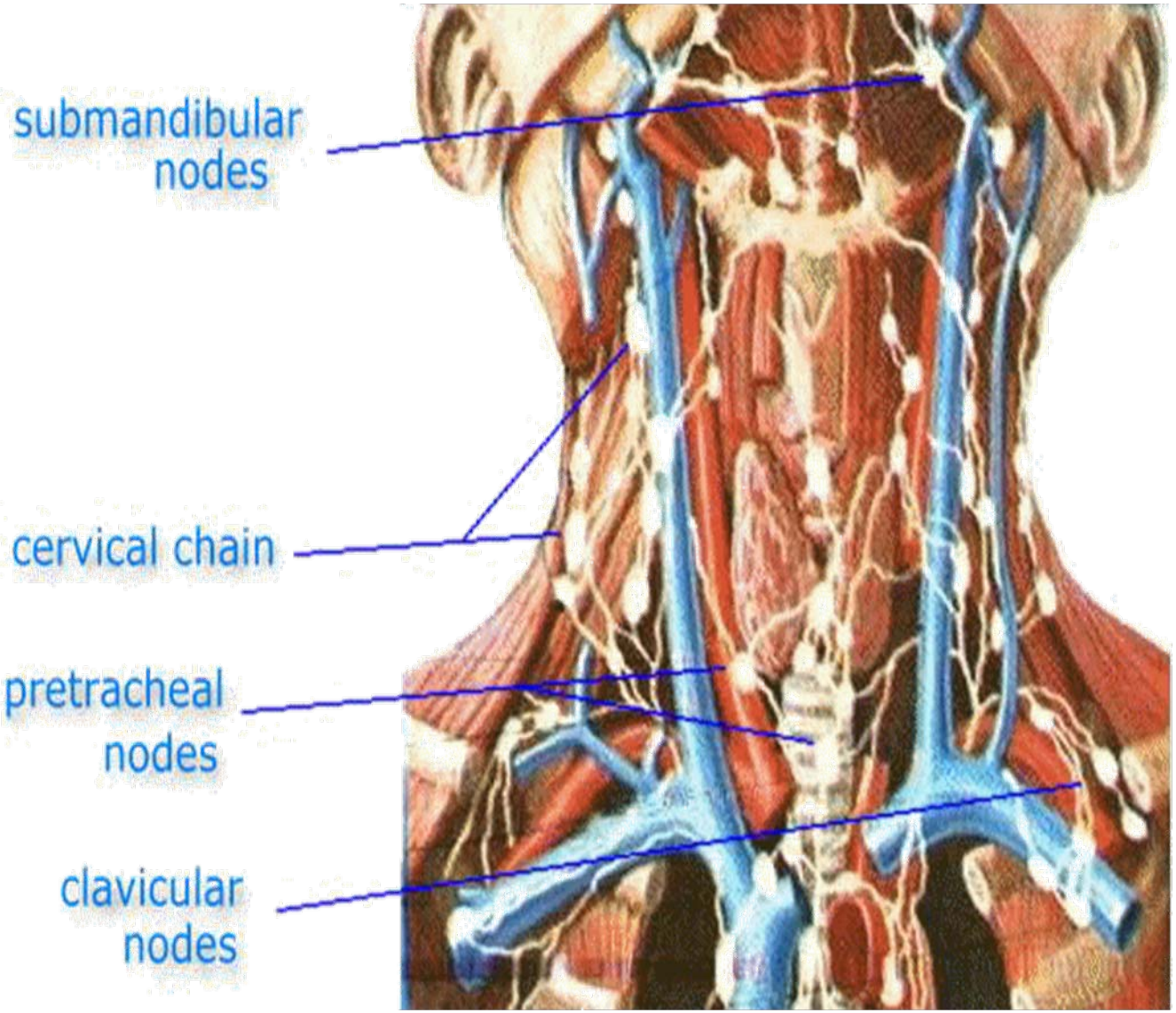
Groin

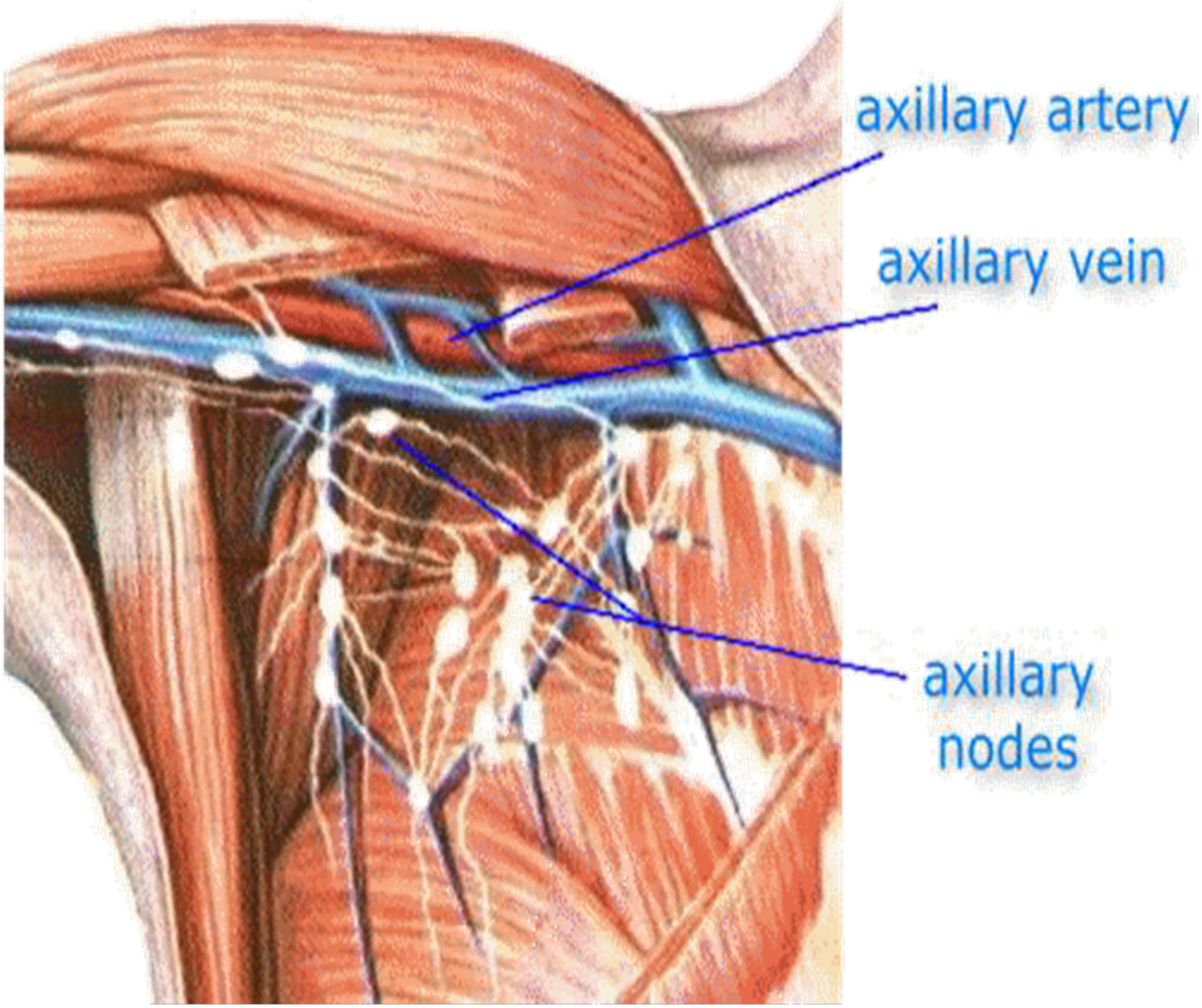
Neck



Three areas where swollen glands occur


preauricular node
mastoid nodes
parotid node
cervical chain
jugular vein
carotid artery


submandibular nodes
cervical chain
pretracheal nodes
clavicular nodes


axillary artery
axillary vein
axillary nodes

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

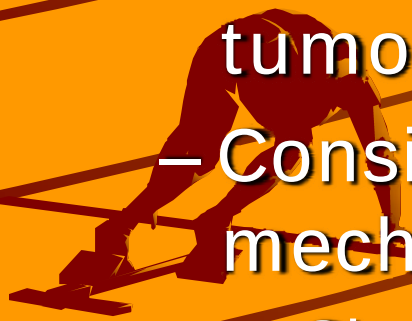
- First line
  - Reflexes
- Second line
  - Phagocytosis
  - Inflammation
  - Fever
  - Protective proteins
  - Natural killer cells
- Third line
  - Specific immunity

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)

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

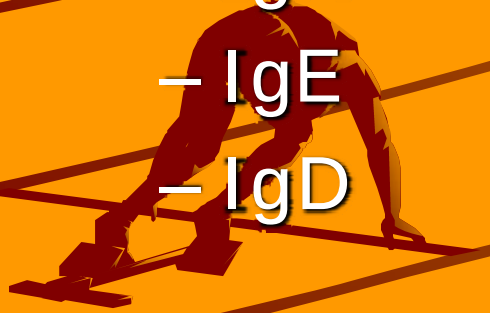
- Each cell involved in specific immune responses
  - Responds to one kind of foreign antigen
- Develop in bone marrow (fetal)
  - T cells migrate to & mature in thymus
    - Then migrate to lymph nodes/nodules/spleen
  - B cells mature in bone marrow
    - Migrate to lymphatic tissue
    - Differentiate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

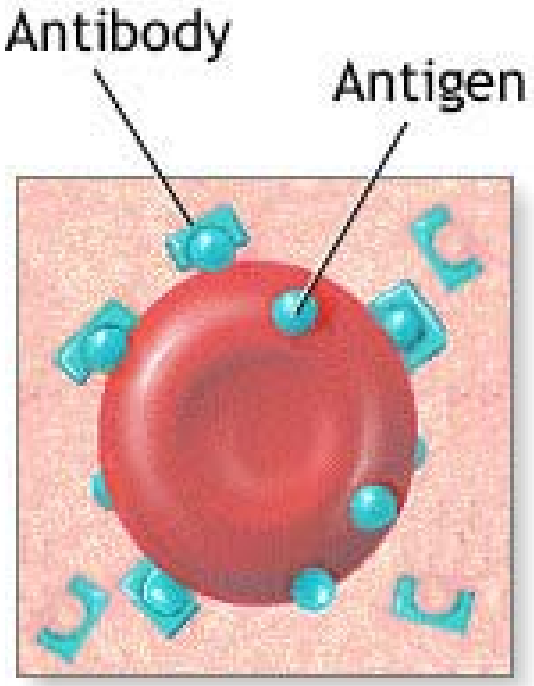
Antibodies

- 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





Red blood cell

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

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

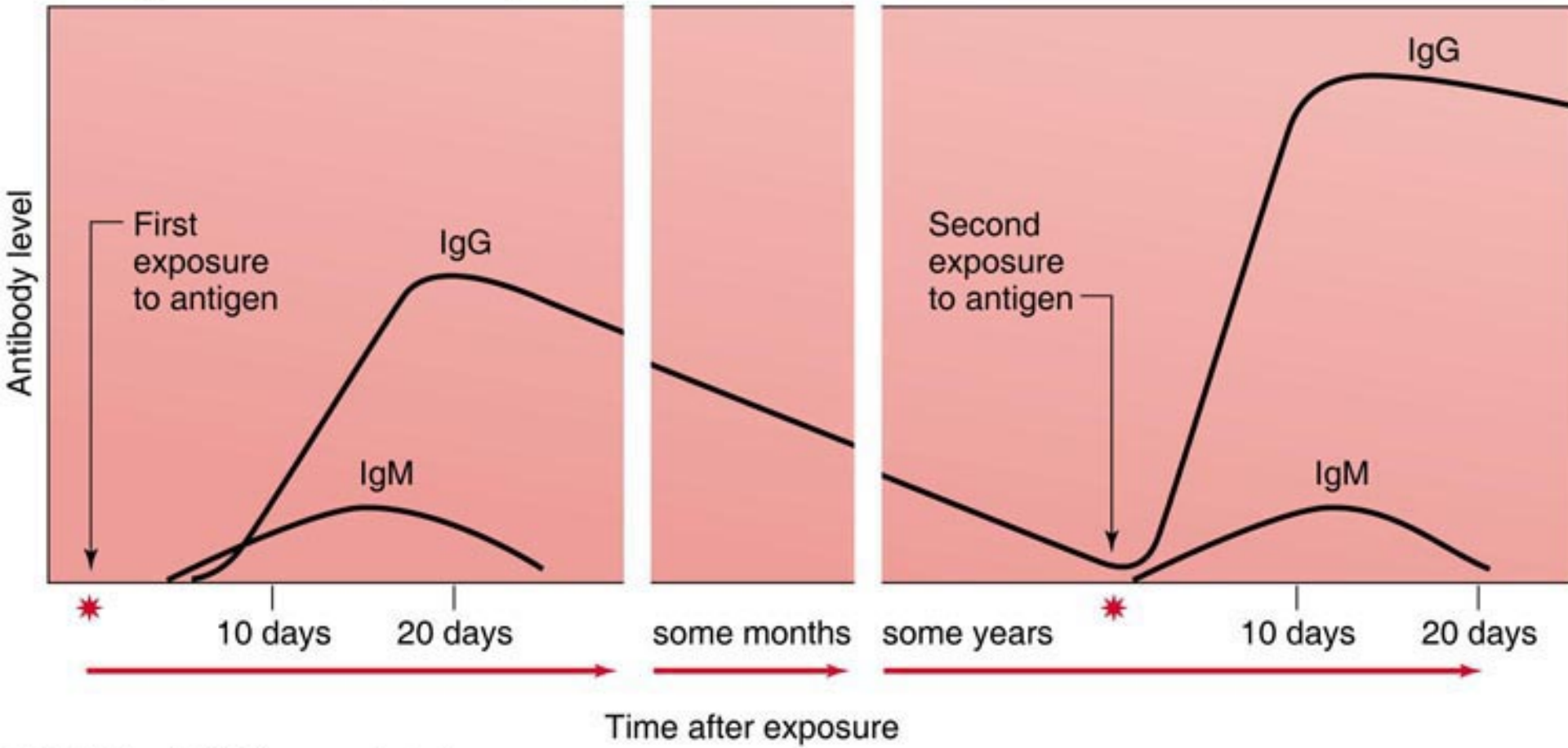
Humoral Immunity

- 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

Primary and secondary antibody responses



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

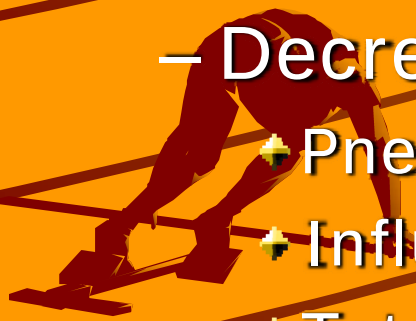
- Passive immunity
  - Antibodies obtained from another source
    - Mother to fetus
  - Artificially acquired
    - Involves injection of pre-formed antibodies
    - ie; tetanus immunoglobulins
- Active immunity
  - Individual produces own antibodies
    - Recovery from disease
  - Artificially acquired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

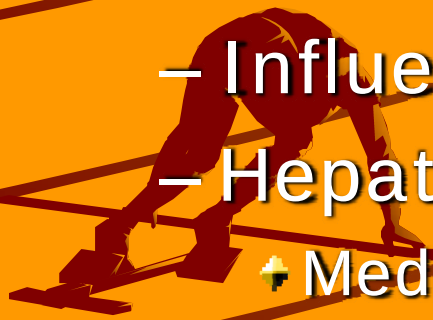
Aging & Immune System

- 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

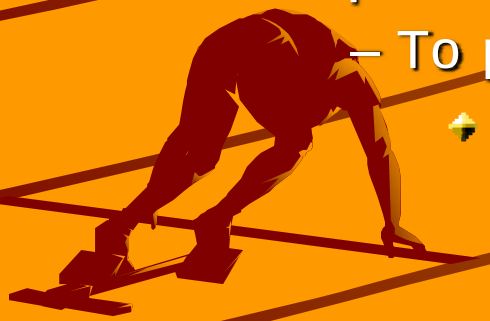


Immune System Assessment

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

Diagnostic Tests
Blood tests

- Screening tests – initially
  - Refer to Table 52-2
  - If abnormal
    - Specific tests may be ordered
      - To precisely identify disorder
        - Refer to Table 52-3

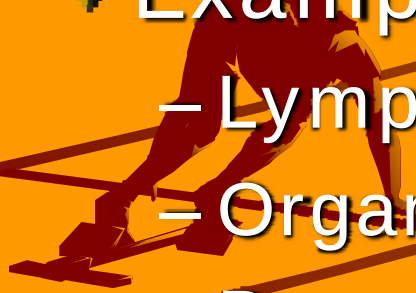


Diagnostic Tests
Radiographic Tests

- 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

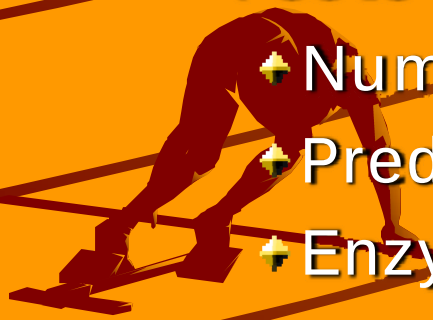


Diagnostic Tests
Skin Tests

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

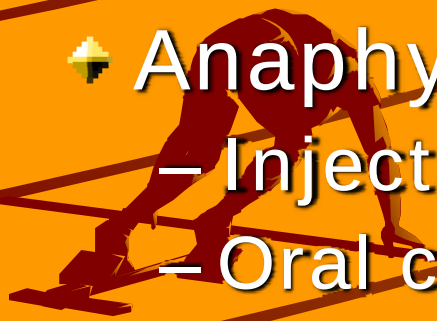
Diagnostic Tests
Gene Tests

- 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

- Spleenectomy
  - 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