Chapter 25
Immune System Disorders

Learning Objectives

- Review specific anatomy and physiology of the immune system, pathophysiology pertinent to immune system disorders
- Describe characteristics of the immune system, including categories of white blood cells, reticuloendothelial system, complement system

Learning Objectives (Cont'd)

- Describe the processes of the immune system defenses, including humoral, cell-mediated immunity
- Define natural, acquired immunity
- Define antigens, antibodies
Learning Objectives (Cont'd)

- Discuss formation of antibodies in the body
- Define specific terminology identified with immune system disorders

Learning Objectives (Cont'd)

- Discuss relative to HIV:
  - Causative agent
  - Body systems affected and potential secondary complications
  - Modes of transmission
  - Seroconversion rate after direct significant exposure
  - Susceptibility and resistance
  - Signs and symptoms
  - Specific patient management exploring possible immunization

Learning Objectives (Cont'd)

- Discuss autoimmune disorders:
  - Systemic lupus erythematosus
  - Insulin-dependent diabetes mellitus
  - Rheumatoid arthritis
  - Celiac disease
  - Chronic active hepatitis
  - Multiple sclerosis
Learning Objectives (Cont'd)

- Define allergic reaction
- Define anaphylaxis

Learning Objectives (Cont'd)

- Describe the incidence, morbidity, mortality rates of anaphylaxis
- Identify risk factors most predisposing to anaphylaxis
- Discuss the anatomy, physiology of organs, structures related to anaphylaxis

Learning Objectives (Cont'd)

- Describe prevention of anaphylaxis, appropriate patient education
- Discuss pathophysiology of allergy, anaphylaxis
- Describe common methods of entry of substances into body
Learning Objectives (Cont'd)

- List common antigens most frequently associated with anaphylaxis
- Describe physical manifestations, pathophysiological principles of anaphylaxis
- Differentiate manifestations of allergic reaction from anaphylaxis

Learning Objectives (Cont'd)

- Recognize signs, symptoms related to anaphylaxis
- Differentiate various treatment, pharmacological interventions used in the management of anaphylaxis
- Describe the clinical significance of abnormal findings in patient with anaphylaxis

Learning Objectives (Cont'd)

- Develop a treatment plan for patients with allergic reactions, anaphylaxis
- Discuss principles of, disorders related to transplantation surgery
- Discuss public health principles relevant to immune system disorders
Immune System Physiology

- Pathogenic agents
  - Prions
    - Infectious agents composed only of proteins
    - Affect structure of brain, nervous tissue
    - Transmissible spongiform encephalopathies
    - Impossible to cure

Immune System Physiology (Cont'd)

- Pathogenic agents
  - Viruses
    - Genetic material uses machinery of other organisms to reproduce
    - Treated with antiviral medications

Immune System Physiology (Cont'd)

- Pathogenic agents
  - Bacteria
    - Prokaryotes with less sophisticated nucleoid, organelles
    - Some have flagella to permit movement
    - Antibiotics kill/timid bacteria growth
    - Classification
Immune System Physiology (Cont'd)

- Pathogenic agents
  - Parasites
    - Live in/on another organism, use to survive without contributing to host’s survival
    - Worms, protozoa
  - Fungi
    - Protists, plant-like organisms, do not contain chlorophyll
    - Yeasts
    - Molds
    - Treated with antifungal medications

- External defenses
  - Skin
  - GI, GU tract
  - Upper respiratory tract
Immune System Physiology (Cont'd)

Nonimmunologic Host Defenses

Internal defenses

Natural immunity

- Inflammatory response and mediators
- Triggers can be infection, injury that causes swelling, destruction at cellular level
- Arterioles, venules, capillaries dilate to push blood to area producing edema
- Various agents and systems fight infection, clear destroyed tissue
**Immune System Physiology (Cont'd)**

- Internal defenses
  - Natural immunity
    - Lymphatic system
      - Lymph flows away from body tissue toward heart, removing debris and pathogens from tissue
      - Lymphatic drainage eventually feeds into the central veins entering the heart (right and left thoracic duct)

**Phagocytes**

**Lymph Node Regions**
Internal defenses
- Acquired immunity
  - Physiology of antigens and immune response
  - Body recognizes foreign substances, antigens
  - Enhancement to inflammatory response
  - Builds memory for certain antigens
  - Amplifies effect of natural immunity

- Humoral immunity
  - B Lymphocytes produce antibodies that destroy bacteria
  - Kills bacteria freely moving in body's tissues and fluids ("humors")
  - Triggers mast cells, complement cascade
Immune System Physiology (Cont'd)

Humoral and Cell-Mediated Immunity

Internal defenses

Accquired immunity

Cell-mediated immunity

- T lymphocytes lyse the body cell to kill indwelling pathogen
- Activate macrophage allowing it to kill pathogen

Phases of immune response

- Cognitive
- Activation
- Effector
Immune System Physiology (Cont'd)

- Factors affecting immune system
  - External defenses
    - Skin
    - PPE
    - Exposure prevention
  - Internal defenses
    - Passive immunity
    - Active immunity

Immune System Physiology Pathophysiology and Treatment

- Acquired immunodeficiency
  - HIV and AIDS
    - Targets T lymphocytes with surface marker CD4
    - AIDS always caused by HIV, HIV does not always cause AIDS
    - CDC HIV classification by CD4 count
Immune System Pathophysiology and Treatment (Cont’d)

- Acquired immunodeficiency
  - HIV and AIDS
    - Risk factors
      - Blood, semen, vaginal, cervical secretions
      - Vaginal, anal intercourse, fetal placenta, open mucous membranes/wounds
      - IV drug abuse
      - Heterosexual, homosexual, bisexual activity
      - Blood transfusion before 1985
      - Prenatal, perinatal, postnatal maternal-neonatal transmission
    - PPE, if exposed follow agency exposure plan

- Field evaluation, treatment
  - If history shows HIV, ask if AIDS developed

- Patient and family education
  - Explain difference between HIV and AIDS
  - Transmission routes
  - Prevention

- Lymphoma
  - Cancerous
  - Affects B and T lymphocytes, stem cells
  - Manifests in lymph nodes
Immune System Pathophysiology and Treatment (Cont'd)

- Acquired immunodeficiency
  - Leukemia
    - Cancer disorder of blood cells
  - Many involve granulocytes

Immune System Pathophysiology and Treatment (Cont'd)

- Autoimmune disorders
  - Systemic lupus erythematosus (SLE)
  - Type 1 insulin-dependent diabetes mellitus
  - Rheumatoid arthritis
  - Progressive systemic sclerosis
  - Celiac disease
  - Chronic active hepatitis
  - Multiple sclerosis

Systemic Sclerosis
Hypersensitivity disorders
- Type I: immediate hypersensitivity
  - Anaphylaxis
  - Urticaria
  - Anaphylactoid reactions
Immune System Pathophysiology and Treatment (Cont’d)

- Hypersensitivity disorders
  - Type II: cytotoxic hypersensitivity
    * Cell membrane triggers IgG/IgM antibodies directed against it

- Immune complex hypersensitivity
  * Antigen-antibody complexes not promptly removed by reticuloendothelial system

- Delayed hypersensitivity
  * Caused by CD4 lymphocytes, not antibodies

Immune System Pathophysiology and Treatment (Cont’d)

- Transplantation disorders
  - Cadaveric transplantation
  - Crossmatch
  - Human leukocyte antigens
  - Allografting
  - Isografting
  - Xenografting
  - Autografting
Field Management

- Patient assessment
  - Life-threatening conditions
  - Assess airway, supplemental O₂
  - Complete secondary survey
  - Complete history

Field Management (Cont’d)

- Treatment summary
  - Allergic reactions managed with:
    - Antihistamines
    - IV
    - Beta agonists
    - Epinephrine
    - Glucagon
    - Steroids
    - Vasopressors
    - O₂

Public Health and Immunity

- Immunization summary
  - Prevent acquired immune system disorders
  - Prevent disease
Public Health and Immunity (Cont’d)
- Immunizations recommended for EMS providers
  - Childhood vaccinations
  - Hepatitis B
  - Annual influenza
  - Tetanus toxoid
  - Weaponized

Public Health and Immunity (Cont’d)
- HIV and public health
  - Developing mechanisms to reduce transmission
  - Developing treatments
  - Developing vaccine

Chapter Summary
- Immune system includes both internal and external defenses to protect against pathogens
- Pathogens include prions, viruses, bacteria, parasites, fungi
Chapter Summary (Cont’d)

- Internal defenses are divided into natural and acquired immunity
  - Natural immunity is nonspecific, defends against all potential pathogens in a similar way (e.g., inflammatory response)
  - Acquired immunity is specific to a particular pathogen (e.g., vaccination)

Chapter Summary (Cont’d)

- Immune system can fail, causing immunodeficiencies, which may be acquired/congenital
  - Congenital immunodeficiencies, such as severe combined immunodeficiency syndrome, are present at birth and are often genetic
  - Acquired immunodeficiencies, such as HIV, must be transmitted to patient, usually infectious

Chapter Summary (Cont’d)

- Autoimmune diseases are present when the immune system response attacks its own tissue (e.g., MS, SLE)
- Hypersensitivity disorders manifest themselves as excessive responses to antigen uncomfortable/dangerous for patient
  - Type I (immediate), type II (cytotoxic), type III (immune complex-mediated), and type IV (delayed)
Chapter Summary (Cont’d)

- Anaphylaxis is an example of type I hypersensitivity, drug reactions are an example of type II, poststreptococcal glomerulonephritis is an example of type III, and tuberculosis skin testing is an example of type IV hypersensitivity.

Chapter Summary (Cont’d)

- Transplant recipients can have two different types of problems involving the immune system:
  - Immune system can function too well and reject the transplanted organ.
  - When the immune system is suppressed to avoid rejection, other opportunistic infections can develop because of lack of a normal immune response.

Chapter Summary (Cont’d)

- Meticulous attention to personal protective equipment, standard precautions are important when treating all patients, especially those with communicable immune system disorders:
  - Includes complying with vaccination requirements for health providers, specific missions, encouraging the public to comply with universal vaccination recommendations.