

ALLERGY– CLINICAL IMMUNOLOGY

LEARNING OBJECTIVES FOR MEDICAL STUDENTS

Prepared by
**The American College of Allergy,
Asthma and Immunology**

Introduction

Allergy/Clinical Immunology Learning Objectives for Medical Students has been published by the American College of Allergy, Asthma & Immunology (ACAAI) to promote the education of medical students in a clinical setting. Many medical schools do not have departments of allergy/clinical immunology that contribute to education of medical students in these common and important diseases. For this reason, these *Learning Objectives* have been developed to encourage greater appreciation of areas within the field of allergy and clinical immunology that are relevant for primary care practice.

The ACAAI encourages the utilization of board-certified allergists/clinical immunologists in communities where no university faculty in our field is available. As many social and economic pressures change the availability of funding for graduate education, clinical training in practice settings will become even more important.

Allergy/Clinical Immunology Learning Objectives for Medical Students was first published in 1982 by the American Association of Certified Allergists, edited by Drs. Robert M. Miles and Edward J. O'Connell. The 1996 revision was produced by the College's Family Practice Training Programs Committee: Drs. Jean Chapman and Jay Portnoy, co-chairs; and Drs. Lawrence Chiaramonte, Richard Lavy, Myron Lipkowitz, Allan T. Luskin, Lyndon Mansfield, Edward O'Connell, John O'Loughlin, Richard Weber, and Robert Zuckerman. This current 2005 revision was produced by Drs. Marianne Frieri, David Lang, D. Betty Lew, Allan Luskin, and Jay Portnoy.

Allergy Asthma & Clinical Immunology

Elective for Medical Students

This is a clinical rotation about common, chronic diseases affecting both children and adults. This elective should be most helpful for medical students who are in third or fourth year.

Students should be introduced to allergy, asthma & clinical immunology and become familiar with the skills of history taking, examination of patients, laboratory techniques, and interpretation of the results as they relate to the specialty. There should be involvement in inpatient and outpatient management of conditions such as asthma, rhinitis, atopic dermatitis, anaphylaxis, drug reactions, food reactions, and urticaria/angioedema. Students should learn how to approach problems associated with immunodeficiency and autoimmune states. They should become familiar with immediate hypersensitivity skin testing, pulmonary function testing, and the indications for allergen immunotherapy.

A typical week of activities could include hospital rounds, departmental conferences, learning of ongoing clinical or basic science research and informal discussions with the allergy/immunology consultant as well as evaluation of the patients. Students should observe the administration of immunotherapy, immediate hypersensitivity skin testing and pulmonary function testing procedures, and should be given time to do detailed new and follow-up examinations of the patients.

Informal discussion sessions with the allergist/clinical immunologist may include the following subjects:

1. Asthma & other reversible lung disorders - diagnosis, differential diagnosis, pathophysiology and categorization of severity, goal development, treatment and development of a self-management action plan.
2. Status asthmaticus - diagnosis and treatment.
3. Non-asthmatic immunological lung disease (i.e. Hypersensitivity Pneumonitis).
4. Rhinitis - classification, diagnosis and treatment.
5. Care of patients with asthma and or/allergic rhinitis during pregnancy and other special populations such as infants and the elderly - changes in pulmonary physiology, use of drug therapy, and/or use of immunotherapy.
6. Drug reactions - diagnosis and treatment.
7. Food reactions - diagnosis and treatment.
8. Contact dermatitis - diagnosis and treatment.
9. Atopic dermatitis - diagnosis and treatment.
10. Stinging insect reactions - diagnosis and treatment.
11. Anaphylaxis - diagnosis and treatment.
12. Urticaria/Angioedema - diagnosis and treatment.
13. Vasculitis and other systemic inflammatory disorders.
14. Use and interpretation of diagnostic tests using Evidence-Based Medicine
Indications for performance of:
 - a) Pulmonary function tests
 - b) Immediate hypersensitivity skin testing
 - c) In vitro serum IgE allergen specific assays
 - d) Optional: Clinical laboratory immunologic techniques for HIV, immunoglobulin and rheumatologic assays.
15. Clinical immunology - components of the immune system, immunological reactions, and the more common immunodeficiency states.

Medical Student Allergy-Immunology Elective Sample Goals and Objectives

Example: Asthma

1. Gain familiarity with diagnosis, differential diagnosis (vascular ring, foreign body aspiration, cystic fibrosis, bronchiolitis, etc.) and current and novel treatment of asthma.
2. Display proficiency with history taking and examination of patients.
3. Become familiar with immediate hypersensitivity skin testing, office pulmonary function testing and the indications for immunotherapy in diagnosis and management of asthmatic patients.
4. Appreciate the utility of the allergist/immunologist for cost-effective care of the asthmatic patient in the ambulatory setting.
5. Understand the role of allergy as a provoking or perpetuating factor for asthma.
6. Learn the indications for hospitalization of acute exacerbation of asthma, status asthmaticus, and appropriate care of asthmatic patients under-going surgery or birthing.
7. Learn when to refer a patient to allergy/immunology service.

ACTIVITIES

Office/Clinic

1. Examine patients with allergic diseases under the supervision of a consultant.
2. Participate in allergy/clinical immunology consultations.
3. Observe immediate hypersensitivity skin testing.
4. Observe pulmonary function testing and understand methacholine testing
5. Observe administration of immunotherapy.

Hospital

1. Make hospital rounds with the allergist/clinical immunologist.
2. Observe care of asthmatic patients with acute exacerbations of status asthmaticus.
3. Observe pre- and post-operative care of controlled asthmatics undergoing surgery or birthing.

Asthma Care

Goal

The medical student should be able to diagnose asthma, describe the pathophysiological mechanisms responsible, take an appropriate clinical history, and outline a general program of management.

Objectives

Upon completion of this rotation, the student will be able to:

1. Diagnose asthma
 - a) Discuss the criteria for making a diagnosis of asthma in young children and in adults.
 - b) Discuss the differential diagnosis of asthma and how to rule out each possibility.
2. Discuss the use and interpretation of diagnostic tests for asthma
 - a) History.
 - b) Physical exam for asthma (e.g. wheezing, rhonchi, rales, stidor).
 - c) Various spirometric and methacholine tests of lung function.
 - d) The use of peak flow meters.
 - e) Allergy skin tests.
 - f) In vitro tests of specific IgE.
3. List factors responsible for airway obstruction in asthma and differentiate asthma from emphysema and vocal cord dysfunction.
4. Identify asthma triggers and how to control and avoid them
 - a) Infection (e.g. sinusitis, viral URIs).
 - b) Irritants (e.g. tobacco smoke).
 - c) Exercise.
 - d) Allergens and environmental factors (e.g. dust mite, animal dander, cockroaches, molds).
5. Discuss the complexity of asthma pathophysiology:
 - a) IgE mechanisms.
 - b) Early and late phase events.
 - c) Role of various cells and their mediators.
6. Discuss the different classes of drugs used in the medical management of asthma and their side effects; including:
 - a) Relievers
 - i) β_2 agonists
 - ii) anticholinergics
 - b) Controllers
 - i) steroids, inhaled and systemic
 - ii) leukotriene modifiers
 - iii) Long-acting β -agonists
 - iv) theophylline (methylxanthines)
 - v) cromolyn and nedocromil
 - vi) anti-IgE
7. Categorize asthma severity using criteria defined in the 1997 NHLBI Guidelines.
8. Develop an appropriate treatment plan:
 - a) Use of controllers for persistent asthma.
 - b) Development of a self-management asthma action plan using the “zone method”.
9. Define and explain the management of status asthmaticus.
10. Discuss the impact of asthma on the quality of life.
- e) Medications (e.g. beta-blockers, NSAIDs).
- f) Intrinsic factors (e.g. emotions).
- g) Hormonal changes during pregnancy.

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Rhinitis Care

Goal

The medical student should be able to diagnose rhinitis, take an appropriate clinical history, and outline a general program of management.

Objectives

Upon completion of this rotation, the student will be able to:

1. Diagnose rhinitis
 - a) Describe the signs and symptoms of various types of rhinitis
 - b) Develop a differential diagnosis of rhinitis including:
 - i) seasonal allergic rhinitis,
 - ii) perennial allergic rhinitis and perennial nonallergic rhinitis,
 - iii) vasomotor rhinopathy
2. Discuss the pathophysiology of allergic rhinitis.
3. Discuss the use and interpretation of diagnostic tests for rhinitis
 - a) History
 - b) Physical exam
 - c) Nasal smears
 - d) Immediate hypersensitivity skin tests
 - e) In vitro tests of specific IgE
 - f) Role of nasal provocation
4. Identify rhinitis triggers and how to avoid them:
 - a) inhalants
 - b) irritants
 - c) physical factors
 - d) endocrine factors
 - e) household allergens (mite, animals danders)
 - f) outdoor allergens (with knowledge of seasons, trees, grasses, weeds and molds)
 - g) infections
5. Describe methods to manage allergic rhinitis:
 - a) Environmental control
 - b) Medications
 - i) antihistamines
 - ii) sympathomimetics
 - iii) topical cromolyn sodium and azelastine
 - iv) nasal and systemic corticosteroids
 - c) Immunotherapy
6. Describe the natural history of allergic rhinitis and vasomotor rhinopathy.
7. List the complications of allergic rhinitis (sinusitis, orthodontic problems, otitis media, sleep disorders, worsening asthma).
8. Evaluate the impact of allergic rhinitis on the quality of life.
9. Discuss allergic/nonallergic conjunctivitis.

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Care of Pregnant Patients Who Have Asthma and/or Allergic Rhinitis

Goal

The medical student should be able to describe the changes in pulmonary physiology and discuss the treatment of asthma and allergic rhinitis during pregnancy.

Objectives

Upon completion of this rotation, the student will be able to:

1. Describe the changes in upper airway and pulmonary physiology that occur with pregnancy.
2. Discuss the differential diagnosis of dyspnea in pregnancy.
3. Discuss the effects of anti-asthma and rhinitis drugs on development of the fetus and the course of the pregnancy.
4. List the drugs of choice for the treatment of
 - a) asthma – maintenance
 - b) asthma – acute episodes
 - c) respiratory infections
 - d) allergic rhinitis
5. Explain allergy management in pregnancy, including the importance of avoidance measures and the utility of continuation of inhalant allergen immunotherapy in properly selected cases.

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Adverse Drug Reactions

Goal

The medical student should understand the classification and pathophysiology of drug reactions.

Objectives

Upon completion of this rotation, the student will be able to:

1. List the classification of adverse drug reactions and give examples, including:
 - a) toxicity
 - b) intolerance
 - c) side effects
 - d) idiosyncrasy
 - e) drug allergy
 - f) anaphylaxis
 - g) drug interactions
2. Summarize immunology of drug reactions and give examples of:
 - a) Type I, Immediate hypersensitivity (IgE-mediated) drug reaction
 - b) Type II, cytotoxic-type drug reactions
 - c) Type III, serum sickness: Arthus-type drug reaction
 - d) Type IV, cellular hypersensitivity type drug reaction
3. Using penicillin as a model,
 - a) define haptens.
4. Explain the roles of clinical history, physical examination, and laboratory testing in the evaluation of adverse drug reactions.
5. Describe immediate hypersensitivity skin testing for penicillin allergy.
6. Describe management of patients who have had adverse reactions to local anesthetics and the utility of immediate hypersensitivity skin testing followed by provocative dose challenge.
7. Identify several drugs that have been implicated in anaphylactic reactions.
8. Discuss recognition and management of patients who have had anaphylactoid reactions from contrast media.
9. Discuss principles of desensitization to pharmacologic agents
 - a) PCN
 - b) ASA
10. Discuss masqueraders of drug reactions in patients with autoimmune disease.

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Adverse Reactions to Foods

Goal

The medical student should be able to classify reactions to food, outline and approach to determine whether a food is implicated in a reaction and identify the pathophysiological mechanism.

Objectives

Upon completion of this rotation, the student will be able to:

1. Classify adverse reactions to foods and give examples of:
 - a) physiologic reaction
 - b) genetic enzymatic reactions
 - c) reactions of intolerance
 - d) toxic reactions
 - e) idiosyncratic reactions
 - f) reactions to food additives, (e.g. carmine, sulfite)
2. List foods commonly implicated in Type I, IgE-mediated, hypersensitivity anaphylactic reactions.
3. Describe the pathophysiology of Type I, IgE-mediated reaction to foods, such as peanuts causing anaphylactic reaction.
4. Explain the approach to the diagnosis of Type I hypersensitivity food reactions, including:
 - a) historical factors.
 - b) findings compatible with such reactions on physical examination.
 - c) laboratory approach; including skin testing, in vitro serum IgE allergen specific assays and subsequent challenges.
5. Describe the management of food allergy
 - a) Elimination diets.
 - b) Use of injectable epinephrine and its storage.
 - c) Medic Alert bracelets.
 - d) Food Allergy and Anaphylaxis Network
 - e) Education including reading food labels and dealing with schools/day care.
6. Describe unusual manifestations of food reactions.

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Contact Dermatitis

Goal

The medical student should be able to recognize the characteristic history, distribution, and appearance of contact dermatitis, identify common causes (poison ivy, metal, perfumes) and outline a program of management.

Objectives

Upon completion to this rotation, the student will be able to:

1. Describe the etiology of this Type IV, cellular hypersensitivity-type reaction.
2. Explain typical distribution of different types of common contactants.
3. Discuss patch tests and when they are indicated.
4. Outline a program of management of contact dermatitis including:
 - a) avoidance
 - b) oral steroids
 - c) topical steroids
 - d) soothing skin soaks
 - e) antipruritic drugs
 - f) recognition that no prophylactic injections are available

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Atopic Dermatitis

Goal

The medical student should be able to diagnose atopic dermatitis, identify aggravating factors, and outline a program of management.

Objectives

Upon completion of this rotation, the student will be able to:

1. Diagnose “atopic dermatitis” (eczema).
2. List the differential diagnosis of atopic dermatitis and identify typical laboratory findings.
3. Describe the physical findings in atopic dermatitis.
4. Discuss the triggers of atopic dermatitis, including:
 - a) irritants, such as soaps.
 - b) allergens, including foods, mites.
 - c) infections, including streptococcal and staphylococcal.
5. List the complications of atopic dermatitis.
6. Outline a program to manage atopic dermatitis, including:
 - a) environmental control.
 - b) baths.
 - c) lubricants.
 - d) topical steroids.
 - e) pimecrolimus, tacrolimus.
 - f) diet.
 - g) treatment of complications, for example, impetigo, eczema herpeticum and corticosteroid side effects.
7. Discuss the natural history of atopic dermatitis.

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Stinging Insect Reactions

Goal

The medical students should be able to classify and differentiate the various stinging insects, know the type of insect sting reactions that can occur, understand the approach to diagnosis of insect sting anaphylaxis, and be able to outline the indications for immunotherapy and management of anaphylactic reactions.

Objectives

Upon completion of this rotation, the student will be able to:

1. List the insects that are members of the order Hymenoptera.
2. List common insects that may be responsible for untoward reactions, but are not of the order Hymenoptera, for example: kissing bug, mosquito, deerfly and spider.
3. Identify where in the natural habitat one could typically find a honeybee, wasp, yellow jacket, hornet and fire ant.
4. Differentiate the reactions that can occur after insect stings, including:
 - a) normal reactions.
 - b) exaggerated local reactions.
 - c) IgE mediated reactions.
 - d) toxic reactions.
5. Discuss the pathophysiology of an IgE mediated reaction to a stinging insect.
6. Explain the role of venom skin testing and in vitro serum IgE allergen specific assays in the diagnosis of stinging insect hypersensitivity.
7. Describe emergency treatment of:
 - a) local reactions.
 - b) exaggerated local reactions.
 - c) systemic reactions including the acute use of local therapy, antihistamines, epinephrine and steroids.
8. Explain long-term management of the patient with insect sting sensitivity.
9. List indications for venom immunotherapy in the management of IgE mediated (allergic/anaphylactic) potential to Hymenoptera venom.
10. Discuss the elements of avoidance education and provision of epinephrine.

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Anaphylaxis

Goal

The medical student should be able to define anaphylaxis, describe the characteristic signs and symptoms, identify causative agents, and outline a program of emergency management.

Objectives

Upon completion of this rotation, the student will be able to:

1. Define anaphylaxis and list several causes; identify the most common causes.
2. Discuss the pathophysiology of anaphylaxis and describe a typical course of events from exposure to an allergen to life-threatening reaction.
3. List the causes of death from anaphylaxis and identify the most common pathologic findings at autopsy.
4. List the signs and symptoms of anaphylaxis related to:
 - a) skin
 - b) respiratory tract
 - c) gastrointestinal tract
 - d) cardiovascular system
5. Discuss the management of anaphylaxis:
 - a) intramuscular and intravenously-administered epinephrine
 - b) antihistamines
 - c) fluids given intravenously
 - d) endotracheal intubation
 - e) steroids
 - f) vasopressors
6. Discuss the relationship of idiopathic anaphylaxis and systemic mastocytosis.
7. Describe the methods of prevention such as Medi-Alert.

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Urticaria

Goal

The medical student should be able to identify urticaria, know how to assess the role of possible etiologic agents in a cost-effective manner, understand the pathophysiology of the condition, and design a program for management.

Objectives

Upon completion of this rotation, the student will be able to:

1. Define Urticaria and Angioedema – acute and chronic.
2. Discuss the pathophysiology of the urticarial lesion (the weal) including triple response of Lewis.
3. List the categories of known etiologic factors, such as ingestants, injectants, inhalants, disease states and hereditary factors. Discuss the role of autoimmunity and autoimmune markers.
4. Describe the immune-mediated mechanisms, including Types I, II, and III

hypersensitivity mechanisms; nonimmune mechanisms, including direct histamine release; and modifying factors including hormonal agents and medications such as aspirin.

5. Diagnose urticaria using:
 - a) history,
 - b) physical examination and
 - c) appropriate laboratory tests
6. Discuss the natural history of:
 - a) acute urticaria
 - b) recurrent acute urticaria
 - c) chronic urticaria
7. Outline a program of management including:
 - a) environmental control
 - b) antihistamines
 - c) corticosteroids
 - d) other medication
8. Discuss the clinical presentation, laboratory findings and management of hereditary angioedema.

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Procedure: Pulmonary Function Tests

Goal

The medical student should be able to interpret pulmonary function tests.

3. Describe the typical findings of pulmonary function tests including flow loop for asthma, COPD and laryngeal obstruction.

Objectives

Upon the completion of this rotation, the student will be able to:

4. Describe the diagnostic utility and interpretation of the results for:

1. Label the lung capacities and lung volumes in a line drawing.
2. Discuss the diagnostic value of common pulmonary function values that are obtained in an office setting:
 - a) FVC
 - b) Peak Expiratory Flow Rate
 - c) FEV1
 - d) FEV1/FVC ratio
 - e) FEF25-75

- a) methacholine challenge
- b) exercise challenge
- c) antigen challenge
- d) aspirin challenge

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Procedures: Immediate Hypersensitivity Skin Testing

Goal

The medical student should be familiar with the laboratory techniques, clinical role, and interpretation of the findings of immediate hypersensitivity skin testing.

for converting pretest to post test probabilities:

- a) percutaneous tests
- b) intracutaneous tests

Objectives

Upon completion of this rotation, the student will be able to:

1. Describe the techniques of skin testing
 - a) percutaneous
 - b) intradermal
2. Describe the use of the following allergy tests for clinical decision making including likelihood ratios and their use
3. Explain methods of antigen standardization.
4. List medications that interfere with interpretation of skin testing.
5. List 10 antigens available for skin testing and identify clinical indications for performing such skin tests.

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Procedure: In Vitro Allergen-Specific IgE Assays

Goal

The medical student should be able to interpret IgE determinations and in vitro allergen specific assays.

Objectives

Upon completion student will be able to:

1. List IgE levels according to age:
 - a) a newborn
 - b) a one-year-old child
 - c) a ten-year-old child
 - d) an adult
2. Describe the use of the CAP RAST for usefulness in food hypersensitivity reactions.
3. List several conditions in which levels of IgE are elevated; include examples of atopic and nonatopic diseases.
4. Interpret the results of specific IgE assays
 - a) Describe the use of likelihood ratios and disease probabilities for making clinical decisions.
 - b) List likelihood ratios for various in vitro allergen assays.
5. Describe the methods by which in vitro allergen specific IgE assay results are reported.
6. List the advantages and disadvantages of in vitro allergen specific IgE assays and compare them with those of skin testing.

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1. De Shazo RD, Smith DL (eds): Primer on Allergic and Immunologic Diseases. 3rd Edition. JAMA. 1992;268:2785-2996.
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4. Frieri M, Kettelhut B (ed), Murali MR. Laboratory diagnosis of food allergy. In: Food Hypersensitivity and Adverse Reactions. A practical guide to diagnosis and management. ppl 395-408. Marcel Dekker, NY 1999.
5. Kim JS, O’Gorman MRG. Common in vitro tests for allergy and immunology. NWU AIS for Residents and students. Allergy Asthma Proc 2004;25:S57-58.

Clinical Immunology

Goals

The medical student should become familiar with the components of the immune system including T cells, B cells, NK cells, immunoglobulins, complement, phagocytes (neutrophils and macrophages), cytokines, interferons and growth factors; know the classification of immunologic reactions, Types I, II, III, IV, and antireceptor and anti-idiotypic reactions and their clinical significance; and become familiar with some of the more common immunodeficiency states: HIV, CVID and IgA deficiency.

T and B Cell

Objectives

Upon completion of this rotation, the medical student will be able to:

1. Know the basic CD classification.
2. List Th₁ and Th₂ and B cell functions.
3. Discuss briefly the T cell, B cell, macrophage interaction.
4. Relate the therapeutic role of omalizumab (anti-IgE) for management of asthma.
5. Explain the therapeutic role of intravenous immunoglobulin in patients with immunodeficiency and patients with immune dysregulatory states.

Immunoglobulin

Objectives

Upon completion of this rotation, the medical student will be able to:

1. Discuss the various classes of immunoglobulins and their functions.

Bibliography

1. Practice parameters for the diagnoses and management of primary immunodeficiency. *Ann Allergy Asthma Immunol.* 2005;94:S1-S63.
2. Frieri M. Complement related diseases. *Allergy Asthma Proc* 2002;23:319-324.
3. Frieri M. Identification of masqueraders of autoimmune diseases in the office. *Allergy Asthma Proc* 2003;24:421-429.
4. Kaplan J, Anand P, Frieri M. Drug hypersensitivity and autoimmunity in a 20-year-old woman. *Ann Allergy Asthma Immunol.* In press. 2005

Complement

Objectives

Upon completion of this rotation, the medical student will be able to:

1. List the components of the complement system.
2. Discuss the role of complement in common autoimmune and infectious diseases.
3. Discuss briefly the classic and alternative pathways.

Phagocyte

Objectives

Upon completion of this rotation, the medical student will be able to:

1. Give examples of phagocyte diseases.

Cytokine and Interferon

Objectives

Upon completion of this rotation, the medical student will be able to:

1. Discuss an overview of cytokines, growth factors and their role in inflammatory reactions.

Masqueraders of Autoimmune Diseases

Objectives

Upon completion of this rotation, the medical student will be able to:

1. Discuss clinical immunologic disorders that have allergic components and masquerade as common autoimmune diseases.

Classification of Immunologic Reactions

Goals

Upon completion of this rotation, the medical student will be able to give clinical illustrations of:

1. Type I, anaphylactic, immediate, late phase and dual reactions.
2. Type II, cytotoxic reactions.
3. Type III, arthus reaction.
4. Type IV, delayed reaction.
5. Miscellaneous, antireceptor and anti-idiotypic reactions.

Immunodeficiency State

Objectives

Upon completion of this rotation, the medical student will be able to:

1. Classify and give examples of:
 - a) B cell immunodeficiency diseases.
 - b) T cell immunodeficiency diseases.
 - c) Combined B cell and T cell immunodeficiency diseases.
 - d) Phagocyte dysfunction diseases.
 - e) Complement abnormalities.
 - f) Interleukin defects (that is SLE, SSC and SCID).
2. List three laboratory methods of screening for antibody-mediated immunity.
3. List two laboratory methods of screening for cell-mediated immunity.
4. List two laboratory test methods of screening for phagocytic problems.

Bibliography

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5. Mansur A, Theratill J, Young RM, Frieri M. An atypical case of gammaglobulinemia. Ann Allergy Asthma Immunol. 2000;84:583-586.
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5. List two laboratory methods of screening for complement disorders.
6. List three laboratory methods for screening for autoimmune disease.
7. List three laboratory methods for screening HIV disease.
8. Discuss each of the immunodeficiency states and disorders of chemotaxis listed below from the standpoint of:
 - a) History of presenting signs and symptoms.
 - b) Type of organism, clinical condition and predisposition.
 - c) Physical findings.
 - d) Screening procedures for definitive laboratory tests.

Immunodeficiency States

1. Antibody (B cells) immunodeficiency diseases, for example, congenital, X-linked Bruton agammaglobulinemia.
2. Cellular (T cell) immunodeficiency diseases, for example, AIDS (helper T cell deficiency).
3. Combined antibody-mediated (B cell) and cell mediated (T cell) immunodeficiency, for example, chronic granulomatous disease.

Disorders of Chemotaxis

1. Wiskott-Aldrich syndrome.
2. Phagocytic dysfunction diseases, for example, chronic granulomatous disease.
3. Complement abnormalities in immunodeficiency diseases, for example, C3 deficiency.