

# Immune System Disorders

## Lecture 14 – Dr. Gary Mumaugh

### Immunocompromise

- Individuals who are immunocompromised are less capable of battling infections because of an immune response that is not properly functioning
- Examples of immunocompromised people are those that have HIV or AIDS, are pregnant, or are undergoing chemotherapy or radiation therapy for cancer
- Generally speaking, disorders of the immune system (immunocompromises) are grouped into four main categories:
  - Immunodeficiency Disorders
  - Autoimmune Disorders
  - Allergic Disorders
  - Cancers of the immune system

### Immunodeficiency Disorders

- Occur when a part of the immune system is not present or is not working properly
- Two types: Primary
  - Those with which a person is born
  - Results whenever one or more essential parts of the immune system is missing or not working properly at birth because of a genetic defect
  - Each year about 400 children are born in the United States with a serious PI
  - The number of Americans now living with a primary immunodeficiency is estimated to be between 25,000 and 50,000
  - World Health Organization lists over 70 PIs

### 10 Warning Signs of Primary Immunodeficiency - Children

- Four or more new ear infections within 1 year
- Two or more new sinus infections within 1 year
- Two or more months on antibiotics with little effect
- Two or more pneumonia's within 1 year
- Failure of an infant to gain weight or grow normally
- Recurrent, deep skin or organ abscesses
- Persistent thrush or fungal infection on skin or elsewhere
- Need for intravenous antibiotics
- Two or more deep-seated infections including septicemia
- A family history of PID

### 10 Warning Signs of Primary Immunodeficiency - Adults

- Two or more new ear infections within 1 year
- Two or more new sinus infections within 1 year, in the absence of allergy
- One pneumonia per year, for more than 1 year
- Chronic diarrhea with weight loss
- Recurrent viral infections
- Recurrent need for intravenous antibiotics to clear infections

- Recurrent, deep abscesses of the skin or internal organs
- Persistent thrush or fungal infection on skin or elsewhere
- Infection with normally harmless TB-like bacteria
- A family history of PID

### **Secondary (Acquired) Immunodeficiency**

- A loss of immunity caused by a disease process or toxic effect of medication rather than by a failure or defect in T or B lymphocytes
- Can Be caused by several factors:
  - Malnutrition - Inhibits lymphocyte maturation
  - Some viruses, e.g., HIV. Depletes T4-lymphocytes
  - Irradiation - exposure to X-rays and gamma rays
    - Causes a decreased production of lymphocyte precursors in the bone marrow
  - Cytotoxic drugs such as many used in cancer chemotherapy
    - Causes a decreased production of lymphocyte precursors in the bone marrow
  - Corticosteroids – anti-inflammatory steroids
    - Damages lymphocytes
  - Leukemias, cancers of the lymphoid system, metastases
    - Reduces areas for lymphocyte development
  - Aging
    - Adaptive immunity, especially cell-mediated immunity, tends to lessen with aging
  - Removal of the spleen
    - Decreased ability to remove microbes that enter the blood
- A secondary immunodeficiency of current notoriety is of course Acquired ImmunoDeficiency Syndrome or AIDS, a secondary immunodeficiency caused by Human Immunodeficiency Virus (HIV)
- The median incubation period for AIDS is around 10 years

### **Autoimmune Disorders**

- Occur when the body's immune system attacks its own tissue as foreign matter
- This response is a hypersensitivity reaction similar to the response in allergies
- Examples include: Lupus, Scleroderma, and Juvenile rheumatoid arthritis
- About 50 million Americans suffer from some 80 autoimmune diseases, according to the American Autoimmune Related Diseases Association
- Fall into two general types:
  - Those that damage many organs (systemic autoimmune diseases)
  - Those where only a single organ or tissue is directly damaged by the autoimmune process (localized)
  - The distinctions become blurred as the effect of localized autoimmune disorders frequently extends beyond the targeted tissues, indirectly affecting other body organs and systems

## Rheumatoid Arthritis

- Most common AutoImmune
- Inflammatory arthritis affecting 1% population
- S & S
  - Symmetrical small joint pain with pronounced morning stiffness (morning gel), low grade fever, joints deformed
- Diagnosis
  - ESR, RF, ASO titer, HLA (human leukocyte antigen)
  - Joint fluid contains WBC, biopsy rheumatoid nodules
- Treatment
  - Supportive – rest, PT, hold and cold packs, DME
  - NSAIDs, Methotrexate, antimalarials
- Prognosis
  - 50-75% remission in a few years, the rest have progressive disease process and dies 10-15 years premature
- An autoimmune disease causing chronic joint inflammation
- A progressive illness that has the potential to cause joint destruction and functional disability
- Affecting approximately 1.3 million people in USA
- Three times more common in women as in men
- It afflicts people of all races equally
- Can begin at any age, but it most often starts after age 40 and before 60
- In some families, multiple members can be affected, suggesting a genetic basis for the disorder
- Juvenile rheumatoid arthritis (JRA) causes joint inflammation and stiffness for more than six weeks in a child aged 16 or younger
- What causes rheumatoid arthritis?
  - Cause is largely unknown
  - Has a strong genetic link
  - It is suspected that certain infections or factors in the environment might trigger the immune system to attack the body's own tissues
- Symptoms
  - Come and go, depending on the degree of inflammation
  - When body tissues are inflamed, the disease is active
  - The course of rheumatoid arthritis varies from patient to patient, and periods of flares and remissions are typical
  - Inflammation usually symmetrical and of the small joints
  - Pronounced morning stiffness – “morning gel”



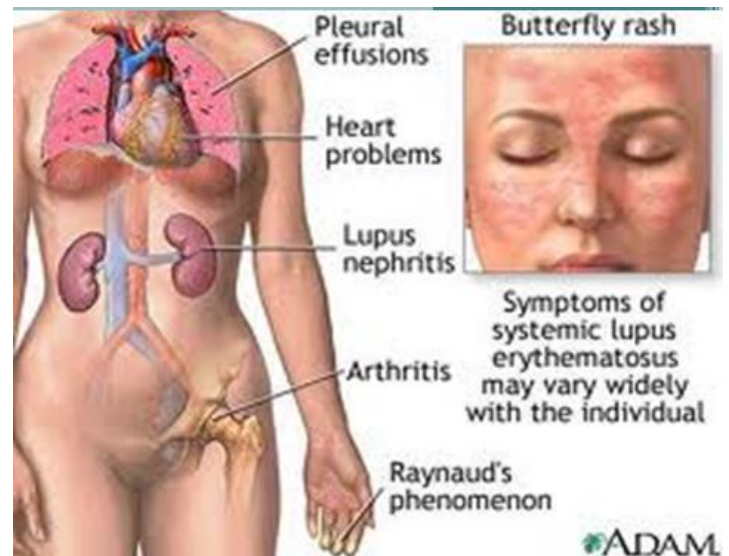
## Rheumatoid Arthritis

- Rheumatoid arthritis and inflammation of organs - can affect organs and areas of the body other than the joints
  - Sjogren's syndrome is inflammation of the glands of the eyes and mouth and causes dryness of these areas
  - Rheumatoid inflammation of the pleura
  - Pericarditis
  - Can have lowered RBC (anemia) and WBC
    - Felty's Syndrome (lowered WBC and splenomegaly)



## SLE – Systemic Lupus Erythematosus

- Generalized AI involving joints, skin, brain, mucus membranes, kidneys, bone marrow, vessel walls
- 50,000 new cases per year
- 90% are young women in their late teens to 30s
- Four types:
  - Systemic lupus erythematosus – most common
  - Drug-induced lupus – resolves when drug stopped
  - Discoid lupus – affects skin with the classic butterfly rash
  - Neonatal lupus – transmitted to fetus
- Spontaneous remissions & relapses is the typical course
- S & S
  - Arthralgia (95%), inflammatory arthritis (90%)
  - Fever (90%), fatigue (81%) rashes (74%)
  - Anemia, kidney involvement, chest pain, alopecia
  - Cognitive dysfunction, photophobia, headaches
  - Blood clotting problems, Raynaud's
  - Mucosal ulcers, pericarditis, vasculitis
  - Seizures, psychosis, peripheral neuropathy
- Diagnosis
  - Confirmed by four or more of the above symptoms
- Treatment
  - Very little western treatment effective – supportive
  - Avoid sun exposure with rash
  - NSAIDs and Other meds
  - Hemodialysis is needed



## Hyperthyroidism – Grave's Disease

- Thyroid gland produces thyroxine hormone
- An autoimmune disorder
- Significantly accelerates metabolism
  - Sudden weight loss, a rapid or irregular heartbeat, sweating, nervousness or irritability
  - Fatigue, muscle weakness, difficulty sleeping
  - Tremor, sweating
  - Changes in menstrual patterns
  - Increased sensitivity to heat
- 8 times more common in women



## Allergic Diseases

- The immune system is overacting to certain antigens (allergens) that are harmful
- This affects 1/3 of population
- Signs and symptoms
  - Most are mild with EENT complaints and skin changes
  - Some reactions are more severe such as mild to moderate asthma, bronchial constriction or anaphylactic reactions
- Atopy
  - The genetic tendency to develop the classic allergic diseases -- atopic dermatitis, allergic rhinitis (hay fever), and asthma
  - Atopy involves the capacity to produce IgE in response to common environmental proteins such as house dustmite, grass pollen, and food allergens
  - From the Greek atopos meaning out of place

## Nearly 1/3 of the Population Has Allergies

- Allergies are an abnormal response of the immune system where the body's defenses react to a usually harmless substance in the environment, such as pollen, animal dander, or food.
- Almost anything can trigger an allergic reaction, which can range from mild and annoying to sudden and life-threatening.

## Allergy Triggers

- Pollen
- Animal Dander
- Dust Mites
- Insect Stings
- Molds
- Foods
- Latex
- Medication
- Fragrance
- Cockroaches

### **Allergy Triggers - Pollen**

- Exposure to pollen from trees, grasses, and weeds can trigger hay fever or seasonal allergies.
- Symptoms include sneezing, runny nose, nasal congestion, and itchy, watery eyes.
- Treatments include over-the-counter products, prescription drugs, and allergy shots.
- Prevent symptoms by staying indoors on windy days when pollen counts are high, closing windows, and running the air conditioning.

### **Allergy Trigger – Animal Dander**

- Proteins secreted by oil glands in an animal's skin and present in their saliva can cause allergic reactions for some.
- The allergy can take two or more years to develop and symptoms may not subside until months after ending contact with the animal.
- Make your bedroom a pet-free zone, avoid carpets, and wash the animal regularly. A HEPA filter and frequent vacuuming may also help. Allergy shots may be beneficial.

### **Allergy Triggers – Dust Mites**

- Dust mites are microscopic organisms that live in house dust.
- They thrive in areas of high humidity and feed on the dead skin cells of humans and their pets, as well as on pollen, bacteria, and fungi.
- Help prevent dust mite allergies by covering mattresses, pillows, and box springs, using hypoallergenic pillows, washing sheets weekly in hot water, and keeping the house free of dust collecting-items such as stuffed animals, curtains, and carpet.

### **Allergy Triggers – Insect Stings**

- Symptoms include extensive swelling and redness from the sting or bite that may last a week or more, nausea, fatigue, and low-grade fever.
- Rarely, insect stings may cause anaphylaxis, with symptoms including difficulty breathing, hives, swelling of the face, throat, or mouth, rapid pulse, dizziness, or a sharp drop in blood pressure.
- For those severely allergic, epinephrine should be administered immediately after a sting; allergy shots are recommended to prevent anaphylaxis with future stings.

### **Allergy Triggers - Molds**

- Molds produce allergens, irritants, and in some cases, potentially toxic substances.
- Inhaling or touching mold or mold spores may cause allergic reactions in sensitive individuals.
- They can be found in damp areas such as basements or bathrooms, as well as in grass or mulch.

### **Allergy Triggers - Foods**

- Milk, shellfish, nuts and wheat are among the most common foods that cause allergies.
- An allergic reaction usually occurs within minutes of eating the offending food.
- Symptoms, which can include asthma, hives, vomiting, diarrhea, and swelling around the mouth, can be severe.
- Treatment with antihistamines or steroids is recommended. In life-threatening situations, an epinephrine injection is needed.

### **Allergy Triggers - Latex**

- Latex in gloves, condoms, and certain medical devices can trigger latex allergy.
- Symptoms include skin rash, eye irritation, runny nose, sneezing, wheezing, and itching of the skin or nose.
- Allergic reactions can range from skin redness and itching to anaphylaxis, a serious reaction which can cause difficulty breathing, hives, and sudden gastrointestinal problems.

### **Allergy Triggers - Medication**

- Symptoms of allergies to medications, such as penicillin or aspirin, can range from mild to life-threatening and can include hives, itchy eyes, congestion, and swelling in the mouth and throat.
- Treatment with antihistamines or steroids is recommended.
- For coughing and lung congestion, bronchodilators may be prescribed.
- For severe symptoms, epinephrine may be needed.

### **Allergy Triggers - Fragrance**

- Fragrances found in products including perfumes, scented candles, laundry detergent, and cosmetics can have mild to severe health consequences.
- For most people, symptoms abate once the scent is out of range. For some, repeated exposures cause an increase in symptoms that occur more often and last longer.

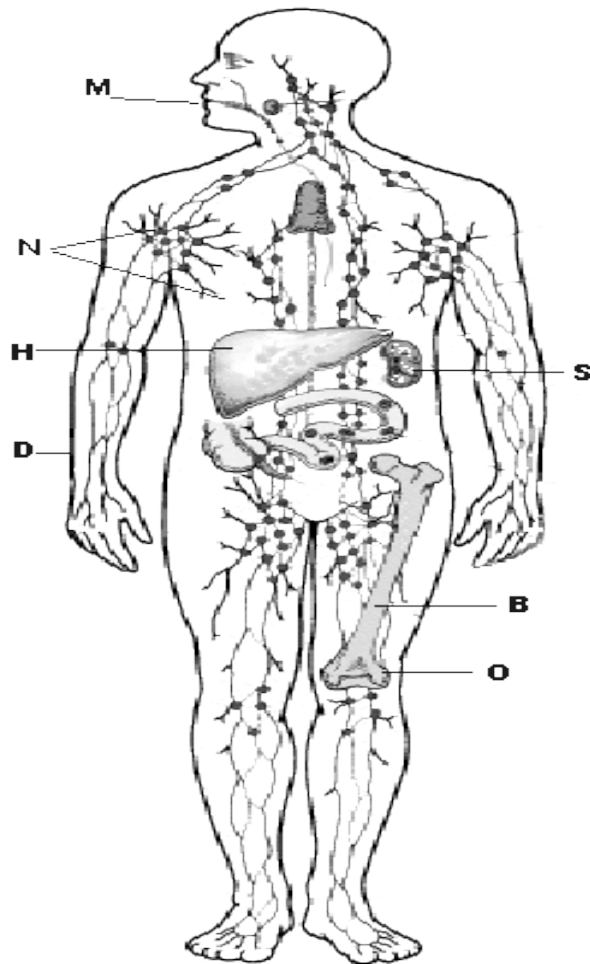
### **Allergy Triggers - Cockroaches**

- It can be difficult to eradicate cockroaches from your home, especially in a warm climate, or if you live in an apartment building where bugs can pass back and forth to a neighboring unit.

### **Cancers of the Immune System**

- Examples include: Lymphoma and Leukemia
- In addition, organ transplant patients are at great risk for complications due to either rejection of the organ or infection
- Another potential detriment to the body's immune system is caused by blood transfusions as the body may not always respond well to foreign sources of plasma





Lymphoma can present anywhere normal lymphocytes – blood cells that provide immune defense -- are found.

- N lymph nodes
- H liver (hepatic)
- L lung (not shown)
- B bone marrow
- S spleen
- P pleura (lung lining - not shown)
- O bone
- D skin
- M mucosal linings - nose, stomach, eyes, etc.

Lymphoma is not one cancer, but a name for a group of related cancers that arise when a Lymphocyte (an immune cell) becomes malignant.

When a lymphocyte becomes malignant it's biological behavior is arrested at its stage of development.

Lymphoma cells may grow to fast or fail to die, and accumulate to form tumors in the body, most commonly in the lymphatic system -- the network of lymph nodes and channels that filter blood and

### Cancers of the Immune System

- As a whole, disorders within the immune system occur due to inappropriate, excessive or insufficient signals sent out by the immune system in response to warning indications
- Typically, inflammation and infection appear as the two major signs of immunity break-down
- Symptoms of inflammation include:
  - Redness in the area
  - Pain in the area
  - Swelling of the affected area
  - Warmth of the affected area
  - Pus (sometimes)
  - Fever
  - General discomfort, uneasiness, or ill feeling (malaise)
  - Muscle aches
  - Agitation or confusion



### **Available Treatments Options**

- Immunodeficiencies occur when one or more of the components of the immune system is defective
- Factors that contribute to worsening an organism's immunodeficiency quotient include: nutrition (malnutrition more accurately), obesity, alcoholism, drug abuse, extreme age factors, i.e., infants and seniors

### **Immunization**

- Infectious diseases have historically been the leading cause of death in the human population
- Within the past century, two important techniques have been formulated to prevent the spread of infectious diseases: sanitation and immunization
- Immunization works by introducing an antigen, which derived from a disease causing organism, stimulates the immune system in an effort to deliver a barrier of immunity against that organism

### **Immunosuppression**

- Anti-inflammatory drugs (the most powerful of which are corticosteroids) are used to control the effects of warmth and swelling
- Because these drugs tend to be accompanied by a high degree of toxic side effects, they are often prescribed in conjunction with cytotoxic (immunosuppressive) drugs
- When inordinate amounts of tissue damage are present, immunosuppression drugs are often utilized for they serve to inhibit overactive T-cells' abilities to respond to signals
- The problem with these drugs is that they are indiscriminate in their killing of cells and, hence, may cause harm to other body parts

### **Immunosuppression**

- There seems to be a genetic predisposition for some autoimmune diseases
- Viral or bacterial infections of some sorts can precipitate autoimmune disease
  - It seems an infection with certain pathogens will trigger an immune response that cross-reacts with antigens present in the body
- Endocrine hormones affect the severity of autoimmune disease
  - Estrogen promotes autoimmune reactions, while androgen inhibits them through unknown mechanisms
- Stress and neurotransmitters can cause physiological changes that worsen the autoimmune disease

### **Immune System: Stress & Break-downs**

- Along with disorders that adversely affect the immune system, internal factors such as stress have also been shown to contribute to deficient immune systems
- Stress has been identified as factor on account of the nature of the body's response in dealing with this problem
- In the case of chronic stress, after frequent activation of the autonomic nervous system--aspects of the immune system become compromised
- Studies have indicated that how one contends with their stress on daily basis can prove to reduce the impact such external factors have upon their immunity system's functioning capabilities
- This is on account of the fact that when one is stressed their endocrine system is continually activated thus causing a persistent stimulation of the immune system
- Therefore, behavioral modification techniques, i.e., effective coping strategies, have proven extremely helpful in reducing the pressure put on the immune system
- The social environment has the ability to play a huge role in immune functioning
- Along with the immune system, it is said that an individual's cardiovascular system can also benefit from conditional behavioral modification and social support