

Immune Study Guide Part 1

Immune Basics

Antigen: Substance that triggers an immune response. Typically, each person's body recognizes its own antigens and becomes tolerant and does not see own cells as a threat.

With autoimmune disease, the body does not recognize own antigen covered cells and attacks them.

Antibody- An antibody is a protein produced by the body's immune system when it detects harmful substances, called antigens. Examples of antigens include microorganisms (bacteria, fungi, parasites, and viruses) and chemicals. Antibodies attack and kill the "foreign microorganisms" and help defend the body from infections and diseases.

Two categories of immunity: **Innate and Acquired**

Innate Immunity

- **Present at birth**
- First- line defense against pathogens (Skin, Hair, cough, mucous membranes, phagocytes, and granulocytes)
- WBC – Neutrophils and monocytes
- Not antigen specific
- Quick response time- within minutes!
- No prior exposure to organism necessary to attack.

Acquired Immunity

Acquired immunity has subcategories.

Natural Acquired Active Immunity- Contact with antigen through infection (Chickenpox, measles, and mumps)

Artificially Acquired Active Immunity- Immunization with antigen (vaccine for chickenpox, measles, and mumps)

Natural acquired passive immunity- Transplacental and colostrum transfer maternal immunoglobulins from mother to baby.

Artificially acquired passive immunity- Injection of serum antibodies from 1 person to another person who does not have antibodies. Antivenoms (Injection of hepatitis B immune globulin)

Immunosenescence is a process of immune dysfunction that occurs with age that decreases the ability to respond to infection and takes longer to heal.

Mononuclear phagocytes play a key role in the first line of defense against invading microbes.

- **Lymphocytes** are a type of white blood cell. They play a significant role in your immune system, which helps your body fight disease and infection.
 - o **B lymphocytes**, also called B cells, create a type of protein called an antibody.
 - o **T lymphocytes** are part of the immune system and develop from stem cells in the bone marrow. They help protect the body from infection and may help fight cancer.

Helper T cells are arguably the most important cells in adaptive immunity, as they are required for almost all adaptive immune responses. They not only help activate B cells to secrete antibodies and macrophages to destroy ingested microbes, but they also help activate cytotoxic T cells to kill infected target cells.

Immune response has 3 main functions:

1. **Defense- from invasion of microorganisms & prevent development of infection by attacking foreign antigens & pathogens.**
2. **Homeostasis- damaged cells are digested and removed. This maintains uniformity of different body cell types.**
3. **Surveillance- mutations continually arise in the body but are normally recognized as foreign cells and destroyed.**

Human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS)

HIV is a retrovirus that goes through a 7-step process to invade, replicate, and overtake a host cells immune system by attacking and using the body's immune response CD4 cells.

1. Binding-HIV attaches itself to the surface of CD4 cell.
2. Fusion- HIV and CD4 cell membrane fuse allowing HIV to enter CD4 cell.
3. Reverse Transcription- HIV enzyme used to convert HIV RNA into HIV DNA inside of the CD4 cell.
4. Integration- HIV uses integrase enzyme to insert its HIV DNA into the DNA of the CD4 cell.
5. Replication- HIV is a part of the CD4 cell DNA and begins to use the machinery of the CD4 cell to make protein building blocks to make more HIV.
6. Assembly-New HIV proteins and HIV RNA move to surface of the cell and assemble into immature (noninfectious) HIV.
7. Budding- Newly formed immature HIV pushes itself out to host CD4 cell and releases protease enzyme which breaks up long protein chains in the immature HIV virus, creating the mature (infectious) virus.
(Each step has an antiretroviral therapy class to stop the specific process/step.)

HIV transmitted through contact with certain body fluids.

Blood

Semen

Rectal fluids

Vaginal secretions

Breast milk

For transmission to occur, the HIV in these fluids must get into the bloodstream of an HIV-negative person through the mucous membranes found in the rectum, vagina, mouth, or penis or through open cuts or sores, or by direct injection from a needle or sharp object.

- The most common mode of transmission is unprotected sexual contact with a person who has a high HIV viral load.

- It is not possible to transmit HIV sexually if the person with HIV has an undetectable viral load. However, the person with HIV is immunocompromised and is higher risk to contract other STI's so safe sex practices should still be a priority!
- Semen, vaginal secretions, rectal fluid, and/or blood, all have lymphocytes that may contain HIV.
- Sexual activities that cause trauma to local tissues increase the risk for transmission.
- Genital lesions from other sexually transmitted infections (STI's), such as herpes or syphilis, increase the chance of transmission.

*Safe sexual practices need to be taught even if patient HIV result comes back as undetectable.
1. Medication may stop working. 2. More susceptible to STIs 3. May forget to take medication which may lead to drug resistance.

- Sharing drug paraphernalia infected with HIV or other blood-borne organisms. (Needles, syringes, straws, and other equipment) *Think about items that people use to consume drugs either through mouth, nose, or vessels.
- * If exposed to HIV through dirty needle or being bitten, report immediately to employee health.
- Blood donations- Receiving blood transfusions. Blood is screened but should educate about the possibility of contracting HIV from blood product.
- Puncture wounds-HIV positive patients blood injected/ inserted into HIV negative persons skin via needle or another sharp object. Risk is higher of contracting HIV if HIV positive person has a high viral load (a lot of HIV cells in their bloodstream)
- Splash exposures- HIV positive person's blood on skin with an open lesion.

Mother to child transmission

- 25% of infants born to women with untreated HIV tested HIV positive.
- Risk for transmission is less than 1% if treated with antiretroviral therapy (ART) if HIV+ and pregnant.

Two main measures of progression of HIV. 1. Level of Viral load 2. CD4 cell count

CD4 cells (also known as CD4+ T cells) are white blood cells that fight infection. CD4 cell count is an indicator of immune function in patients living with HIV and one of the key determinants for the need of opportunistic infection (OI) prophylaxis.

- For many years, the body can produce new CD4+ T cells to replace the destroyed cells. However, over time the ability of HIV to destroy CD4+ T cells exceed the body's ability to replace the cells. The decline in the CD4+ T cell count impairs immune function.
- CD4 levels and what they indicate-
 - ❖ Acute infection Flu-like symptoms:
 1. Fever, swollen lymph nodes, sore throat, headache, malaise, nausea, muscle and joint pain, diarrhea, or a diffuse rash
 2. Occurs about 2 to 4 weeks after infection.
 3. Highly infectious because this is the period that the body does not have appropriate cells formed to fight HIV invading and taking over the CD4 immune response cell.
 - ❖ Normal: 800-1200 μ L=low to undetectable HIV Viral load in blood (immune system working at a high level to fight off HIV from invading CD4 cells to replicate.)

- ❖ Asymptomatic phase 500-799 μL = medium to high HIV Viral load in blood (immune system is fighting at a moderate level to keep HIV from invading CD4 cells to replicate.) * Teach about high-risk behaviors such as unsafe sex and sharing drug paraphernalia. Educate patient to get tested for HIV because they won't have symptoms, and we want to prevent spread.
 1. Symptomatic phase 200-499 μL = High HIV Viral load in blood (immune system is fighting at a low level to keep HIV from invading CD4 cells to replicate.) Patient will begin to exhibit symptoms: persistent fever, frequent night sweats, chronic diarrhea, recurrent headaches, and severe fatigue. Other infections can occur during the symptomatic phase: Shingles, persistent **vaginal candida or oral thrush**, herpes, **Kaposi Sarcoma**, Oral **Hairy leukoplakia** or bacterial infections.
- ❖ AIDS phase below 200 μL =Extremely high HIV Viral load in blood (immune system is not able to fight HIV replication and **prophylactic antibiotics should be started to help prevent opportunistic infections. Prophylactic antibiotics should also be started if taking an immunosuppressant medication because they are high risk for opportunistic infections.**
- ❖ Criteria to diagnose AIDS- must have at least one.
 1. CD4 below 200 μL
 2. Bacterial, Fungal, Viral or Protozoal opportunistic infection.
 3. Opportunistic cancer (Kaposi sarcoma is included in this category)
 4. Muscle wasting syndrome- loss of 10% or more of ideal body mass.

Pneumocystis Jirovecii Pneumonia (PJP) is caused by yeast-like fungus and is an opportunistic infection to people who have a weakened immune system. Typically occurs when patient is in the AIDS stage because their immune system cannot fight off infections.

Treatment is trimethoprim/sulfamethoxazole (Bactrim or Septra) for 3 weeks IV or PO.

Window Period- Typically 3 weeks-3 months for test to show HIV positive.

- HIV cannot be cured, but ART can delay disease progression by decreasing viral replication. When taken consistently and correctly, ART can reduce viral loads by 90% to 99%, which makes adherence to treatment regimens extremely important.
- The major advantage of using drugs from different classes is that combination therapy can inhibit viral replication in several different ways, making it more difficult for the virus to recover and decreasing the likelihood of drug resistance.
- A major problem with most drugs used in ART is that resistance develops rapidly when they are used alone or taken in inadequate doses. Thus, combinations of three or more should be used.

*Herbal therapy- St. John's wort and over the counter drugs- Antacids, Proton pump inhibitors, and various supplements should be avoided when taking ART therapy.

Preventing transmission of HIV-

- o Pre-exposure prophylaxis (PrEP) Tenofovir/ emtricitabine (Truvada) ← This is a form of ART.
- o Used in conjunction with proven prevention interventions such as: condoms, risk reduction counseling, and regular HIV testing.

Antiretroviral Therapy (ART)

- Issues to consider when selecting an initial drug regimen include the ability of the patient's HIV to resist specific drugs, potential medication side effects, existing co-morbidities, and dosing schedules.
- This is a critical decision, because the first treatment regimen is generally the patient's best chance for success.
- Missing even a few doses can lead to drug resistance.
- * ART is not a cure to HIV it only slows progression by preventing the replication of HIV which allows CD4 counts to increase and decreases/suppresses the HIV viral load within the bloodstream.
- Goal of ART therapy is for HIV viral level to become undetectable= untransmittable. Patient must still wear condoms or barriers during sexual intercourse activities because patient is more likely to contract STIs or medication could become resistant or partner taking ART could have forgotten or skipped a dose.
- Ask at-risk patients and educate:
 - Received blood transfusion or clotting factors before 1985? Blood product could have been contaminated with HIV.
 - Shared needles or drug paraphernalia with another person? How often are you using illicit drugs?
 - Had a sexual experience with your penis, vagina, rectum, or mouth in contact with these areas of another person? Suggested to have HIV testing at least once a year if sexually active. If in an open relationship suggested to get tested every 3- 6 month.
 - Had a sexually transmitted infection? Suggest safe sex practices such as using condoms or other protective sexual barriers. Ensure that if STI was present, that it was treated.
 - *Educated the patient that it will be easier to contract opportunistic infections such as STIs when HIV positive.
 - *Educate about risk of HIV transmission from mother to baby if HIV is untreated.
- Nursing interventions can help the patient to
 - (1) Adhere to drug regimens- missing a couple of doses can allow drug resistance.
 - (2) Promote a healthy lifestyle that includes avoiding exposure to other sexually transmitted and blood-borne diseases- Avoid sharing drug paraphernalia, High protein diet. Plenty of rest, reduce stress, and eliminate tobacco, alcohol, and drug use if possible.
 - (3) Protect others from HIV- Safe sex practices like condoms or sexual barriers. Abstinence is the most effective strategy.
 - (4) Maintain or develop healthy and supportive relationships- Support groups can be helpful. Doctor patient relationship is very important. Educate family and friends to stop stigmas.

- (5) Maintain activities and productivity- Suggest continuing activities that prevent social isolation or depression. Suggest the patient find activities that make them feel happy or important/ valued. Exercise would be helpful to build lean muscle mass prior to muscle wasting syndrome occurring in AIDS phase.
- (6) Explore spiritual issues
- (7) Come to terms with issues related to disease, disability, and death- Educate patient about disease process and prognosis. Educate about importance and possible livelihood if they take ART combination correctly.
- (8) Cope with symptoms caused by HIV and its treatments.
- They will be confronted with complex treatment decisions; feelings of loss, anger, powerlessness, depression, and grief; social isolation; altered concepts of the physical, social, emotional, and creative self; the possibility of death; and/or thoughts of suicide.
- Educating the patient and allowing the patient to ask questions is important.

*There is an increasing rate of HIV in people over 60 years old. Stigmas may prevent them from getting tested and treated.

Polypharmacy is a possible problem for older patients with more health issues. ART could interact with medications that older patients take for other health problems.