Outline

1. System: Immune system
2. Organ: Bone Marrow
3. Anatomical location of bone marrow
4. Anatomical description of bone marrow: physiology
5. Types of cells and tissues present: B cell, T cells
6. Functions of the organ, Bone marrow
7. Homeostasis: maintains homeostasis by fighting off harmful pathogens; keeping body safe
8. Prediction: Body would stay sick/cannot fight off pathogens and serious problems will occur
9. Disease processes and any anatomical changes: Aplastic anemia (Bone marrow disorder), AIDS (immune disorder)
10. Relationships to other systems: works together with the lymphatic system
11. References : At least 5 resources

Slide 1: Cover slide

Slide 2: What does the immune system do?

- The immune system is very important in keeping our body safe so that all the organs and systems can work in optimal condition. Some things that the immune system does are:
- Destroys and neutralizes pathogens:
    - The immune system is the complex collection of cells and organs that destroys and neutralizes pathogens that would cause a disease or even death to the human body. They will fight off and protect the body from any harmful pathogens.
- Works along the lymphatic system:
    - The lymphatic system is associated with the immune system to the point that the two systems are hard to distinguish or tell apart.
- Lymphatic system helps with filtering through pathogens:
    - The lymphatic system is a system of vessels, cells, and organs that carries excess fluids to the bloodstream and helps with filtering out the pathogens from the blood.

Slide 3: The Bone Marrow:

- The bone marrow is an important organ that is a part of the immune system. It is:
- Primary Lymphoid/hematopoietic Organ:
    - The lymphoid organs are where lymphocytes mature, proliferate, and are selected. This will then enable them to attack pathogens without harming other cells of the body that are in the same area.

- Immune Regulatory Organ:
    - The bone marrow is capable of fine tuning immunity and may become a key component in immunotherapy/vaccination.
- Produces important blood cells:
    - Bone marrow is the tissue found inside the center and the epiphysis of bones. New blood cells are created in those areas.
    - B cells, a type of lymphocytes, are also produced and matured in the bone marrow as well.
    - T cells are another type of lymphocytes. They are also found in the bone marrow and play a huge role in the adaptive immune system.

Slide 4: Immune Response:

- When the body comes in contact with any antigens that could create harm to the body, it goes through immune responses. Immune response is:
- How the body recognizes and defends itself against antigens:
    - The immune response is how the body recognizes and defends itself from bacteria, viruses, and foreign substances that could be harmful to the body.
    - Antigens are not only bacteria, viruses, or fungi, it is also substances like toxins, drugs, chemicals, and foregin particles. The body will be able to recognize these and try to destroy them unless they are recognized as normal to the body.
- The body has a few different types of immunity reactions:
    - Innate immunity:
        - This is nonspecific and this is the defense mechanism/system that everyone is born with.
    - Acquired/active immunity:
        - This mechanism/system is done through being exposed to different antigens.
    - Passive immunity:
        - This immunity is due to antibodies that are created by another body that is not your own. For example, babies have passive immunity by the help of their mothers.

Slide 5: Innate Immunity:

- Born with this defense mechanism
- Protects against all antigens
- Barriers are key for protection:
    - Barriers are the first line of defense in the immune response.
- IMAGE : these are examples of innate immunity
    - Some examples: cough reflex, enzymes in tears and skin oils, mucus, skin, and stomach acid

Slide 6: Acquired/Active Immunity:

- Immune system will build its defense this way
    - So just like the title, the immune system will build its defense by acquiring or exposing itself to different antigens.
- Also known as adaptive immune system
- IMAGE : acquired immunity is a natural occurrence

Slide 7: Passive Immunity:

- Antibodies produced in another body and then transferred over
    - Infants are born with antibodies that are transferred through the placenta from their mothers.
- Antibodies that are given by mothers disappears between ages 6 to 12 months
- Passive Immunization:
    - This occurs when the pregnant mother receives a vaccine. The mother's body will produce antibodies, and those antibodies will then get transferred to the baby. It provides immediate protection against antigens, but it is not long-lasting. This is also an example of injection of antiserums.

Slide 8: Where is Bone Marrow Found?:

- What is anatomy? Well, anatomy is the study of the structure. We are going to take a closer look into the anatomy of the bone marrow and where you can find it in the human body.
- Bone marrow is located in the center and the epiphyses of the bone
- There are two types of bone marrow:
    - Red bone marrow
    - Yellow bone marrow
- Bone marrow is a spongy tissue that contains stem cells and are vascularized by blood vessels.
    - The vascular network allows billions of lymphocytes to be able to recirculate through every day.
    - The stem cells are what develops red and white blood cells that carry oxygen to the body and help fight infections. They also help with blood clotting, which is very important.

Slide 9: The Cells That Do Work:

- So stated earlier, the bone marrow is responsible for producing important blood cells. The blood cells that we briefly went over were the B cells and T cells which help with the immune system function.
- B cells are a part of the adaptive immune system
    - The adaptive immune system can either be the active or passive immunity that we talked about earlier.
    - B cells are important because they are able to produce antibodies. However, they cannot produce antibodies until they become activated.

- Activation of B cells must occur to produce antibodies:
  - The B cell can be activated once the antigen that entered the body has been detected by a pre-prepared antibody
- Another important blood cell that plays a role in immunity are the T cells. T cells are also a part of the adaptive immune system, and they are responsible for fighting off antigens.
  - T cells originate in the bone marrow and then go to the thymus to mature. The T cells do not become activated until they come in contact with a specific antigen. Once they find their specific antigen, they will bind to the surface of antigen-presenting cells (APCs).
  - T cells are not activated until T helper cells give them a secondary signal.
    - T cells are partially activated until T helper cells send out another signal to fully activate them. Communication will then occur throughout all the T cells, and they will begin to destroy any pathogen that they see are harmful.

Slide 10: Maintaining Homeostasis:

- What is homeostasis? Homeostasis is when the internal environment of an organism is kept consistent or steady by the systems of the organism itself. This is an important concept because then the organism and all its organs can carry out functions in an ideal manner. When homeostasis is met, there will be minimal problems and everything will work together efficiently.
- The immune system is important for maintaining homeostasis.
  - It is able to interact and respond with the external environment, which will then aid in maintaining the internal environment for the organism.
- The immune system responds to the external environment.
  - This concept is important because it is able to keep out pathogens by the barriers that are put in place by the body.
  - Not only is it a defense mechanism against pathogens and antigens, it also protects the cellular integrity of the body.
- Bone marrow can also aid in maintaining homeostasis with the help of the skeletal system.
  - When bone marrow comes into play with homeostasis, it is called mineral homeostasis. This is more of a function that the skeletal system provides, but, since we are talking about how the bone marrow is an important organ of the immune system, it is a fun fact to learn about. The blood requires a just the right amount of calcium and other minerals to function properly.

    - So when the levels of calcium or other minerals are too high, the bones will then absorb some of the minerals and store it as mineral salts. This is how bones become so hard and compact.
    - When levels of minerals are too low, the bones will then release the minerals back into the blood to restore homeostasis.

Slide 11: What would happen if the immune system wasn't working?

- Without the bone marrow function properly, blood cells would not be produced efficiently or at all. Bone marrow produces many important blood cells that the body needs to maintain homeostasis. The immune system will become affected since B cells and T cells will not be produced efficiently to fight off any infection or antigens.
- Can't fight off infections
- Increased risks of diseases and illnesses
    - Not being able to fight off any antigens will mean the infection or antigens to spread. The more they spread, the more sick the body will become. Depending on how severe or harmful the invading antigen is, it can cause diseases or a really bad infection.
- Organ failure
    - Any really bad infection or diseases that doesn't get treated quickly can start affecting other organs in the body. When the diseases or infections spreading and attacking it can cause organs to fail.
- Death
    - Organ failure can lead to death.

Slide 12: Bone Marrow Disorder: Aplastic Anemia:

- This is a disorder in the blood cells causing it to not be able to produce red blood cells
    - The body basically stops producing new blood cells, and this will cause the body to be fatigued, more prone to infections, and uncontrolled bleeding. It can cause other symptoms like pale skin, prolonged bleeding from cuts, unexplained and easy bruising, and rapid and irregular heart rate.
- Rare and can be life-threatening
    - This condition can develop at any age, and it can occur suddenly. This disorder has connections with other rare disorders as well. People with aplastic anemia can also develop another rare disorder called paroxysmal nocturnal hemoglobinuria. This other rare disorder causes red blood cells to break down pretty rapidly. Those two disorders combined can cause major issues to the body.
    - Another rare disorder that is connected with aplastic anemia is Fanconi's anemia. This is an inherited disease that can lead to aplastic anemia.

Children born with this disorder are usually smaller than normal and have birth defects.

- The common cause for this rare disorder is the immune system attacking the stem cells in the bone marrow.
    - Stem cells in the bone marrow are incharge of producing blood cells like red blood cells, white blood cells, and platelets. When the stem cells become damaged, the bone marrow cannot produce more blood cells causing it to be empty or have a very low supply of it.

Slide 13: Prevention and Treatments for Aplastic Anemia:

- There is no prevention steps for this disorder
- Avoiding toxic chemicals may help lower the risk for the disease but it is not certain
    - Some toxic chemicals to avoid are herbicides, insecticides, organic solvents, and paint removers.
- Treatments for aplastic anemia can vary depending on the severity of the condition and the age of the patient.
    - Some treatments that may be advised are blood transfusions, stem cell transplant, and medication, like immunosuppressants, antibiotics, bone marrow stimulants.

Slide 14: AIDS: Immune System Disorder:

- AIDS stands for acquired immunodeficiency syndrome
- It is a chronic, life-threatening condition that damages the immune system
- It is cause by the human immunodeficiency virus (HIV)
    - HIV interferes with the body's ability to fight off infections and diseases. This can cause many problems to emerge and can make it very life-threatening. Medication needs to be taken so that it can slow down the progression of the disease. It will continue to weaken the immune system if medication is not being taken.

Slide 15: Prevention and Treatments for AIDS:

- There is no vaccine to prevent HIV/AIDS, but there are steps to protect yourself and other from infections
    - To protect yourself it is advised to use a new condom every time you have sex,use a clean needle to inject medication, consider male circumcision, and consider PrEP which can help decrease the risk of getting HIV.
- There is no cure for HIV/AIDS, but medication can be taken to slow down the progression
    - TasP can be taken as medication to keep your partner from being infected. PEP can be taken if you have been exposed to HIV, and this can reduce the risk of being infected. This medication must be taken for 28 days within the first 72 hours of coming in contact.

        - Medications that can control HIV are called antiretroviral therapy (ART). This medication is usually a combination of three or more medications from other drug classes. This medication will be able to help lower the amount of HIV in the blood.
    - The medication has been able to reduce the number of deaths
        - Medication must be taken regularly and as prescribed
        - It will help with keeping the immune system strong, reduce the chances of getting an infections, reduce the chances of developing treatment-resistant HIV, and reduce the chances of transmitting HIV to other people.

References:

Anatomy and Physiology. (n.d.). Retrieved December 03, 2020, from https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

Aplastic anemia. (2020, January 11). Retrieved December 03, 2020, from https://www.mayoclinic.org/diseases-conditions/aplastic-anemia/diagnosis-treatment/drc-20355020

Bonomo, A., Monteiro, A., Gonçalves-Silva, T., Cordeiro-Spinetti, E., Galvani, R., & Balduino, A. (2016, May 17). A T Cell View of the Bone Marrow. Retrieved December 03, 2020, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4868947/

Deane, B., & Patrick Deane As an undergraduate of Human Biosciences at Plymouth University. (2017, August 22). B Cells: The Antibody Factories of the Immune System. Retrieved December 03, 2020, from https://www.lifespan.io/news/b-cells/

Ghanohi, A. (2020, May 26). T Cells - Production of T Cells - Types of T Cells. Retrieved December 03, 2020, from https://teachmephysiology.com/immune-system/cells-immune-system/t-cells/

Henochowicz, S. I. (2020, February 02). Immune response: MedlinePlus Medical Encyclopedia. Retrieved December 03, 2020, from https://medlineplus.gov/ency/article/000821.htm

HIV/AIDS. (2020, February 13). Retrieved December 03, 2020, from https://www.mayoclinic.org/diseases-conditions/hiv-aids/diagnosis-treatment/drc-20373531

Zhao, E., Xu, H., Wang, L., Kryczek, I., Wu, K., Hu, Y., . . . Zou, W. (2012, January). Bone marrow and the control of immunity. Retrieved December 03, 2020, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3251706/