

BIOL 483 - Infection, Immunity, and Evolution of Disease
Spring 2022
Homework

Directions: Read chapter 1, especially focus on sections 1-4 and 1-7 to 1-11 in your text ("The Immune System") by Parham. Read chapter 2, especially focus on sections 2-2 to 2-7 and 2-10 to 2-12 and 2-15. Use the information in these sections to answer the questions below.

How is the overall strategy of the adaptive immune system different from that of the innate immune system?

The innate immune system is the first line of defense of your body. It has a very fast reaction time and responds to pathogens and foreign substances intruding the body. Its defenses are nonspecific, meaning that it handles all foreign pathogens and substances in the same general manner. The innate immune system primarily consists of the skin and mucous membranes as well as immune system cells and proteins that protect the body.

In contrast, the adaptive immune system is slower in responding, however, more specific when targeting the infection within the body. Its main role is to deal with the pathogens that the innate immune system was not able to handle. Unlike the innate immune system, the adaptive immune system can “remember” pathogens as to increase response time the next time the same pathogen enters the body. Furthermore, this memory of pathogens is the main reason why you become “immune” to some diseases as your body has built up the memory to be able to respond and react immediately if those pathogens do find their way into your body again. The adaptive immune system is primarily made of B and T cells as well as the antibodies found in the blood.

What cell line (or group) do the monocytes belong to? What cells do they give rise to and what makes them distinct?

Monocytes are the largest type of leukocytes (white blood cells) that circulate in the blood. They are distinct in that they are bigger than granulocytes and have an indented nucleus. Furthermore, all monocytes look the same which stems their name “monocytes”. In addition, monocytes come from the cell line of the myeloid cells which later branches to sedentary tissue cells called macrophages. Monocytes travel in the blood to tissues, where they mature into macrophages and take up residence.

What is GALT and what makes it visually distinctive?

GALT stands for gut-associated lymphoid tissues; they include the tonsils, adenoids, appendix, and the Peyer’s patches that line the small intestine. The GALT is visually distinctive as it is organized similarly to a lymphatic node by having distinctive B and T cell zones. The GALT is a component of the mucosa-associated lymphoid tissue (MALT) which protects the body from invasion in the gut.

What is the complement system? Which component of the complement system is the most important and why?

The complement system is a system soluble protein that one of first weapons of the innate immune system. It is made by the liver and are present in the blood, lymph, and extracellular fluids. They coat the surface of the bacteria and extracellular virus particles which makes them easily phagocytosed.

The most important component of the complement system is the complement component 3 (C3) as patients lacking C3 are prone to successive severe infections. C3 is always cleaved into a small C3a fragment and large C3b fragment, in which the C3b fragment binds to the pathogen's surface and tags it for destruction by phagocytes. Furthermore, the C3b fragment also helps in organizing the formation of protein complexes that damages the pathogen's membrane. Meanwhile, the soluble C3a fragments aids act as a chemoattractant in recruiting effector cells to the site of infection.

What are Toll-like receptors (TLRs)? What is lipopolysaccharide (LPS)? What is the end result of TLRs binding to LPS?

Toll-like receptors (TLRs) are a family of signaling receptors each having a specific different set of microbial products. The innate immune response varies depending on the type of cell that expresses the TLRs as well as the type of pathogen and the site of infection. For instance, macrophages express TLR4 which targets lipopolysaccharides. Lipopolysaccharides (LPS) are endotoxins that form a major component of the outer membrane of Gram-negative bacteria. The result of TLRs binding to LPS induces a change in the pattern of gene expression in macrophages. The genes for cytokines are induced turning on the innate immune response and inflammation at the site of infection.

What is extravasation?

Extravasation is the process by which neutrophils migrate out of blood capillaries and into tissues.

Four Steps of Extravasation:

1. Interaction between leukocytes and blood vessel walls to slow down the neutrophils
 - a. Rolling → neutrophil roll along the vascular endothelial surface
2. Interactions between the integrins LFA1 and CR3 on the neutrophil and adhesion molecules on the endothelium
 - a. Stop Rolling → tight binding of ICAM1
3. Neutrophil crosses the blood vessel wall
4. Movement of the neutrophil toward the center of infection in the tissue

What are some molecules involved in extravasation?

Molecules involved in extravasation are:

- LFA1 and CR3
- Adhesion molecules → ICAM

• CXCL8

