

MICR422 - Immunology

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 - Office Hours: Mondays 1-3 pm,
Fridays 10-12 pm.
 - *Appointments recommended at ALL TIMES*

Research Interests

- Ruminant/Cervid Immunology, Prion Diseases (Transmissible Spongiform Encephalopathies), Cell Migration and Tumor Cell Metastasis.
- Laboratory Assistants required in B cell Function studies, Breast Cancer Metastasis Studies
 - At least 15 hours per week
 - Send CV/Resume, Transcripts to alan.young@sdstate.edu

Immunology: A few hints...

- Like a language: learn the vocabulary, and the processes will make more sense!
- This is a senior course. I am assuming a prior knowledge of mechanisms of DNA replication, RNA transcription, protein translation, post-translational modifications.
- There is no laboratory associated with this course. Those requiring laboratory coursework should take MICR499, Spring Semester.

Questions for today

- What is immunity?
- Why study the immune system
- What is the difference between the innate and the acquired immune systems?
- What composes the innate immune system?

Introduction

- Immunity: "The state of being resistant" to
 - Infectious Disease
 - Cancer
 - Organ Transplantation

Why is the study of Immunology important?

- To understand the disease process (pathogenesis)
 - Disease **symptoms** frequently are a consequence of the immune response, NOT primarily due to the infectious insult
 - E.g. by cytokines released in response to immune system activation.
 - Interleukin-1 induces fever
 - Bradykinin induces pain.

Why is the study of Immunology important?

- Development of means to **increase** the immune response
 - This is the basis of vaccination, which provides protection against:
 - Viruses - e.g. polio, smallpox
 - Bacteria - e.g. tuberculosis
 - Protozoa - e.g. malaria
 - Cancer - ?????

Why is the study of Immunology important?

- Development of means to **decrease** the immune response
 - Would be useful in:
 - **Transplantation** - to specifically inhibit the immune response to foreign organ grafts
 - **Allergy** - allergic symptoms result due to an inappropriate response to normal environmental factors
 - **Autoimmunity** - several serious diseases result due to the immune system responding to **self** proteins

The study of Immunology therefore overlaps with:

- Microbiology - to understand the microbe's interaction with the host
- Pathology - to understand the mechanisms which regulate the disease process
- Oncology - to understand the role the immune system plays in tumor development and progression
- Surgery - to regulate the immune response to organ grafts
- Other medical sciences including nutrition, rheumatology, neurology, etc.

From the standpoint of host defense, the immune response can be loosely grouped into the **innate** and the **acquired** immune system.

What is the innate immune system?

- Innate immunity is due to a set of physical, cellular, and chemical disease resistance mechanisms which lack the **specificity** and **memory** of the acquired immune system.
 - Vaccination has no protective effect on the innate immune system, which will respond identically to the primary and secondary challenge

What is the acquired immune system?

- The acquired immune system uses a set of cellular and molecular mechanisms to respond **specifically** to infectious diseases, and to develop a more vigorous **memory** response during secondary infection.
 - Vaccination induces a memory response (vigorous) to measles, mumps, rubella, tetanus, etc

	Phagocytes	Antibodies	Lymphocytes	Lymph Nodes
Invertebrates	+	-	-	-
Sharks, skates, rays	+	+(IgM)	+	-
Fish	+	+(IgM,?)	+	-
Reptiles, Amphibians	+	+(2-3 classes)	+	-
Birds	+	+(3 classes)	+	+/-
Mammals	+	+(7-8 classes)	+	+

The innate and acquired immune systems do NOT act in isolation in higher vertebrates, but as a co-operative system

The Innate Immune system is composed of:

- Anatomic Barriers
- Physiologic Barriers
- Phagocytic Barriers
- Inflammatory Barriers

Anatomic Barriers

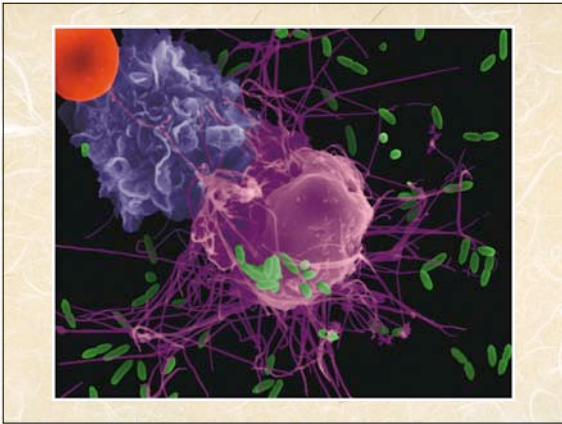
- Skin
 - Sebaceous gland secretions maintain low pH to inhibit growth of microbes
- Mucous membranes
 - Commensal organisms in gut compete with infectious organisms
 - Flow of mucous and consistency prevent bacterial colonization
- Fur/hair/wool (animals)
 - Surface of skin is virtually sterile in many animals

Physiologic Barriers

- Temperature
 - Fever induced by inflammatory mediators inhibits growth of many pathogens
- Stomach acid kills ingested bacteria
- Chemical mediators/enzymes kill many bacteria
 - E.g. lysozyme in tears, other secretions
 - E.g. spermine in sperm
 - E.g. **Complement** (primitive cascade of proteins which kill bacteria and induce the adaptive immune system).

Phagocytic/Cellular Barriers

- Phagocytosis is the uptake of particulate material from the local environment by specialized cells
 - These cells include:
 - **Monocyte/macrophages/(Dendritic Cells)**
 - Langerhans cells in the skin
 - Kupffer cells in the liver
 - Peritoneal macrophages
 - Bronchoalveolar macrophages in the lung
 - **Neutrophils (polymorphonuclear leukocytes-PMNs)**



Inflammatory Barriers

- Any tissue damage will result in a sequence of events which is known as **inflammation**
- The symptoms of inflammation are defined by Celsus as:
 - *Rubor, tumor, calor, dolor, functio laesa*
 - *(redness, swelling, heat, pain, loss of function)*

Summary

- Immunology is the study of the mechanisms used to resist disease
- This knowledge can be used by a number of fields to manipulate the host response
- The immune system can be divided into the **innate** and the **acquired** systems
- The **innate immune system** consists of those **non-specific** means that have evolved to resist disease, including the process of inflammation.

Next Lecture

- **Innate Immunity-Inflammation**
 - Cells of the innate immune system
- **Acquired Immunity**
 - Theories of Acquired Immunity
 - Cells of the acquired immune system
 - *T cells*
 - *B cells*
 - *Dendritic Cells*
