Basic Concepts of Immunology

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Immunology is Important to You as a Future Clinician Because:

1. Failure of the immune system to cope with infection/trauma is the reason for many patient visits

2. Immunological status of your patients dictates treatment decisions

3. Need to protect yourself and your staff from infection
Immune System Components

**Cells and Organs:** thymus, spleen, lymph nodes, stem cells and precursors, T and B cells, macrophages (MØ), neutrophils (PMN), dendritic cells (DC), mast cells and others

**Humoral/Soluble:** antibody, cytokines, complement, acute phase proteins, enzymes, antimicrobials, etc.

### Innate Versus Adaptive Immunity

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Innate Immunity</th>
<th>Adaptive Immunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response time</td>
<td>Minutes/hours</td>
<td>Days</td>
</tr>
<tr>
<td>Specificity</td>
<td>Specific for molecules and molecular patterns associated with pathogens</td>
<td>Highly specific; discriminates even minor differences in molecular structure; details of microbial or nonmicrobial structure recognized with high specificity</td>
</tr>
<tr>
<td>Diversity</td>
<td>A limited number of germ line-encoded receptors</td>
<td>Highly diverse; a very large number of receptors arising from genetic recombination of receptor genes</td>
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<tr>
<td>Memory responses</td>
<td>None</td>
<td>Persistent memory; with faster response of greater magnitude on subsequent infection</td>
</tr>
<tr>
<td>Self/nonself discrimination</td>
<td>Perfect; no microbe-specific patterns in host</td>
<td>Very good; occasional failures of self/nonself discrimination result in autoimmune disease</td>
</tr>
<tr>
<td>Soluble components of blood or tissue fluids</td>
<td>Many antimicrobial peptides and proteins</td>
<td>Antibodies</td>
</tr>
<tr>
<td>Major cell types</td>
<td>Phagocytes (monocytes, macrophages, neutrophils), natural killer (NK) cells, dendritic cells</td>
<td>T cells, B cells, antigen-presenting cells</td>
</tr>
</tbody>
</table>

Table 3-1

*Innate and adaptive immunity

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### Innate Immune Mechanisms of Protecting the Host

<table>
<thead>
<tr>
<th>Organ or tissue</th>
<th>Innate mechanisms protecting skin/epithelium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin</td>
<td>Antimicrobial peptides, fatty acids in sebum</td>
</tr>
<tr>
<td>Mouth and upper</td>
<td>Enzymes, antimicrobial peptides, and sweeping of surface by directional flow of fluid toward stomach</td>
</tr>
<tr>
<td>alimentary canal</td>
<td></td>
</tr>
<tr>
<td>Stomach</td>
<td>Low pH, digestive enzymes, antimicrobial peptides, fluid flow toward intestine</td>
</tr>
<tr>
<td>Small intestine</td>
<td>Digestive enzymes, antimicrobial peptides, fluid flow to large intestine</td>
</tr>
<tr>
<td>Large intestine</td>
<td>Normal intestinal flora compete with invading microbes, fluid/feces expelled from rectum</td>
</tr>
<tr>
<td>Airway and lungs</td>
<td>Cilia sweep mucus outward, coughing, sneezing, expel mucus, macrophages in alveoli of lungs</td>
</tr>
</tbody>
</table>

**Phagocytosis**

1. Bacterium becomes attached to membrane evaginations called pseudopodia
2. Bacterium is ingested, forming phagosome
3. Phagosome fuses with lysosome
4. Lysosomal enzymes digest captured material
5. Digestion products are released from cell

**Inflammation**

6. Tissue damage/trauma releases of vasoactive substances that trigger local increase in blood flow and capillary permeability
7. Vasoactive substances allow access of blood to mesenteric capillaries
8. Neutrophils and other phagocytes
9. Phagocytes engage to site of inflammation/infection
10. Phagocytes engulf and destroy bacteria
11. Bacteria are cleared from infected area
How Does the Innate Immune System Recognize Infection?

- Via Pathogen Associated Molecular Patterns (PAMPs)
- Specific receptors recognize microbial components (LPS, lipoproteins, peptidoglycan, ssRNA etc)
- These receptors are termed Pattern Recognition Receptors (PRRs)
- Examples of PRRs include: Collectins, CRP and Toll-like receptors

Toll-like Receptors (TLRs)
Adaptive Immunity

Active Immunity -

Passive Immunity -

Humoral Immunity -

Cell-mediated Immunity -

Adaptive Immunity
- mediated by lymphocytes
Adaptive Immunity
Cardinal Features

Specificity -

Diversity -

Memory -

Self-Limiting Response -

Recognition of Self vs. Non-self -