TYPES OF IMMUNITY

RAKESH SHARDA
Overview of the Immune System

Immune System

Innate (Nonspecific)
  - Cellular Components
  - Humoral Components

Adaptive (Specific)
  - Cellular Components
  - Humoral Components
Innate immunity refers to an immediate or early antigen-nonspecific defense mechanisms that are present in a host since birth without being induced and are designed to react and/or eliminate any antigen. This is the immunity one is born with.

Adaptive (acquired) immunity refers to antigen-specific induced defense mechanisms that take several days to develop and are designed to react and/or eliminate a specific antigen. This is the immunity one acquires during life.

(Adaptive immunity is found exclusively in vertebrates)
The innate immune responses involve:

- physical barriers
- chemicals - lysozyme, bile salts, sebum, HCl acid, etc
- cells that release inflammatory mediators
- phagocytic cells
- natural killer cells
- humoral factors - complement proteins, acute phase proteins, and cytokines.
Adaptive Immunity

The Adaptive immune responses involves:

- antigen-presenting cells (APCs) such as macrophages and dendritic cells;

- the activation and proliferation of antigen-specific B-lymphocytes;

- the activation and proliferation of antigen-specific T-lymphocytes;

- the production of antibody molecules, cytotoxic T-lymphocytes (CTLs), and cytokines.
## Components of Innate and Adaptive Immunity

<table>
<thead>
<tr>
<th>Innate Immunity</th>
<th>Adaptive Immunity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>physical barriers</strong></td>
<td></td>
</tr>
<tr>
<td>skin, gut Villi, lung cilia, etc</td>
<td>none</td>
</tr>
<tr>
<td><strong>soluble factors</strong></td>
<td></td>
</tr>
<tr>
<td>many protein and non-protein secretions</td>
<td>Immunoglobulins (antibody)</td>
</tr>
<tr>
<td><strong>cells</strong></td>
<td></td>
</tr>
<tr>
<td>phagocytes, NK cell</td>
<td>T and B lymphocytes</td>
</tr>
<tr>
<td>eosinophils, K cells</td>
<td>APCs</td>
</tr>
</tbody>
</table>
I Line of defense

Skin

II Line of defense

Sweat, Sebum, Tears (body toxic fluids)

Phagocytosing cells

III Line of defense

Antibody

Cell Mediated Immunity

Antigen elimination

Acquired Immunity

Chemical barrier

Cellular barrier

Innate Immunity

Physical barrier

Antigen/foreign material

Antigen elimination
1. **Tolerance to self antigens** - under normal conditions, an immune response to "self" antigens (called an autoimmune response) does not occur.

2. **Specificity** – components of adaptive immunity react specifically with the antigen that induced their formation.

3. **Memory** - the adaptive immunological response remembers the antigen for an invariable period of time and upon subsequent exposure to homologous antigen there is an anamnestic immune response, i.e. *strengthens upon repeated exposure*. 
<table>
<thead>
<tr>
<th>Innate Immunity</th>
<th>Adaptive Immunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigen independent</td>
<td>Antigen dependent</td>
</tr>
<tr>
<td>No time lag</td>
<td>A lag period</td>
</tr>
<tr>
<td>Not antigen specific</td>
<td>Antigen specific</td>
</tr>
<tr>
<td>No Immunologic memory</td>
<td>Development of memory</td>
</tr>
</tbody>
</table>
Innate and Adaptive immunity

Innate immune system generates signals that
- identify nature of the antigen
- type of effector response to be induced
- whether an adaptive response will be induced

The antigen presenting cell - APC - is the bridge between innate and adaptive immunity
Classification of Adaptive Immunity

Adaptive Immune System

- Basis of Effector molecules
  - Humoral immunity
  - Cell mediated Immunity
- Basis of mode of development
  - Active Immunity
  - Passive Immunity
Types of Acquired Immunity
(On the basis of effector molecules)

- **Humoral immunity**: Humoral or antibody mediated immunity (AMI) is characterized by the production of antigen-specific immunoglobulin molecules, called as ‘antibodies’, induced in response to an antigen and is mediated by B-lymphocytes. Antibodies primarily defend against extracellular pathogens and toxins. Humoral immunity is so named because it involves substances found in the humors, or body fluids.

- **Cell-mediated immunity**: Cell-mediated immunity (CMI) involves the activation of antigen-specific cells, such as CTLs and macrophages, which destroys the cells harboring antigen. Cellular immunity primarily defend against intracellular pathogens, multicellular parasites, transplanted tissue, and cancer cells.
## Characteristics/Differences of Humoral and Cell mediated Immunity

<table>
<thead>
<tr>
<th>Humoral Immunity</th>
<th>Cell mediated Immunity</th>
</tr>
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<tbody>
<tr>
<td>B-cell dependent</td>
<td>T-cell dependent</td>
</tr>
<tr>
<td>Effecter molecule - antibodies</td>
<td>Effecter – CTL, NK, macrophages</td>
</tr>
<tr>
<td>Effective against extracellular parasites</td>
<td>Effective against intracellular parasites, tumor cells, tissue grafts</td>
</tr>
<tr>
<td>MHC restriction: +/-</td>
<td>MHC restriction:+</td>
</tr>
</tbody>
</table>
Overview of Adaptive Immune Response

**Humoral (antibody-mediated) immune response**

- Antigen (1st exposure)
  - Engulfed by Macrophage (APC)
  - Stimulates Helper T cell
    - Stimulates B cell
      - Gives rise to Plasma cells
        - Secrete Antibodies
        - Defend against extracellular pathogens by binding to antigens and making the pathogens easier targets for phagocytes and complement.
      - Stimulates Memory B cells
- Antigen (2nd exposure)
  - Stimulates Memory helper T cell
  - Stimulates Cytotoxic T cell
    - Gives rise to Active cytotoxic T cells
      - Defend against intracellular pathogens and cancer by binding to and lysing the infected cells or cancer cells.

**Cell-mediated immune response**

- Antigens displayed by infected cells activate Cytotoxic T cell
  - Stimulates Helper T cell
    - Stimulates Memory T cells
      - Stimulates Memory helper T cell
        - Stimulates B cell
          - Stimulates Helper T cell
            - Stimulates Macrophage (APC)
              - Engulfed by Antigen (1st exposure)
The Interrelation of AMI and CMI

1. Th cells activate B cells to produce antibodies against T-dependent antigens (usually protein in composition).

2. In antibody-dependent cell-mediated cytotoxicity (ADCC), NK cells, macrophages, and other leukocytes lyse antibody-coated cells that are too large to be phagocytosed.
Types of Acquired Immunity
(On the basis of mode of development)

**Active immunity**, in which the host develops an adaptive immunological response and produces the cells and factors responsible for the immunity. Active immunity can persist for a long time in the host.

**Passive immunity** is acquisition by a host of immune factors which were produced in another animal, i.e., the host receives pre-formed antibodies and/or immuno-reactive lymphocytes. Passive immunity is typically short-lived and usually persists only a few weeks or months.
INFECTION OF "X"

"ACTIVE IMMUNITY"

"PASSIVE IMMUNITY"

Resistance

"MILK (COLOSTRUM)"

"ANTIBODIES TO "X" ARE PRODUCED"

"NEWBORN"

"MOTHER"

Resistance
# Characteristics/Differences of Active and Passive Immunity

<table>
<thead>
<tr>
<th>Active Immunity</th>
<th>Passive Immunity</th>
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<tbody>
<tr>
<td>Participation of hosts’ immune system</td>
<td>No participation</td>
</tr>
<tr>
<td>Long lived</td>
<td>Short lived</td>
</tr>
<tr>
<td>Memory</td>
<td>No memory</td>
</tr>
<tr>
<td>Lag period</td>
<td>No lag period</td>
</tr>
<tr>
<td>Titer is time dependent</td>
<td>Immediately high titer</td>
</tr>
</tbody>
</table>
Types of Active & Passive Immunity

- **Active immunity**
  - Natural (e.g. infection)
  - Artificial (e.g. vaccination)

- **Passive immunity**
  - Natural (e.g. maternal Ab)
  - Artificial (e.g. Hyper immune Serum)
Immunity: Active and Passive

Active immunity
- Naturally acquired
- Artifially acquired
- Mumps 12/9/79

Passive immunity
- Naturally acquired
- Artificially acquired
- Serum
### Advantages and Disadvantages of Passive Immunization

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>immediate protection</td>
<td>no long term protection</td>
</tr>
<tr>
<td></td>
<td>serum sickness</td>
</tr>
<tr>
<td></td>
<td>risk of hepatitis and Aids</td>
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<tr>
<td></td>
<td>graft vs. host disease (cell graft only)</td>
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