HANDOUTS
#1 – Roadmap

TODAY

Immune Reactions, Antigen/Antibody,

Core Notes Chapters 1 & 2
and Appendix 1,2 (Precipitin Curve, Ab Labeling)
Three "Limbs" of the Immune Response

**Antigen**
- Proliferation
- Differentiation
- Antigen-specific triggering

**B**
- Antigen processing (dendritic cells, MΦ et al.)
- B cell
- B cell differentiation
- Production of antibodies (AFC)

**T**
- T-cell functions
  - TH1: Delayed type hypersensitivity, (DTH); e.g. tuberculin reaction
  - TH2: "help"
  - T-cell killing: virus-infected cells, transplants
  - T-cell killing: virus-infected cells, transplants
  - Mixed Lymphocyte Reaction (MLR)
  - Tolerance, suppression

**AFC**
- Antibody
- Complement
- Killing of bacteria
- Inflammation
- Inactivation of viruses
- Allergy

**AUTOIMMUNITY**

**AFFERENT**

**CENTRAL**

**EFFERENT**

**Effector functions**
Blood monocyte

Phagocytic, “APC”, can “process” and “present” antigen. Tissue-resident dendritic cells are most important APCs.
Blood lymphocyte
T cell or B cell, antigen-specific generation of humoral and cell-mediated immune responses.
Organs of the Immune System…

APCs, T-cells and B-cells populate **Lymphoid Tissues**…

* Lymph nodes
* Spleen
* Peyer’s patches *et al*…
  (+Thymus and Bone Marrow)

…& *travel* via the blood and lymph…
When the Immune System Goes Wrong...

- **Infection** (bacteria, viruses, other parasites)
- **Immunodeficiency** (congenital, acquired, iatrogenic)
- **Allergy** (food/animals/drugs, hay fever & asthma...)
- **Autoimmune disease** (rheumatoid arthritis, lupus *etc.*
- **Contact dermatitis** (poison oak, affordable jewelry)
- **Transplant rejection** (kidney, heart, lung, liver *etc.*
- **Transfusion reactions** (blood typing)
Innate Immunity

*No adaptive specificity, no memory*

*Mucous membranes, phagocytes (RES), complement, anti-bacterial peptides...*

Adaptive Immunity

*Specificity, memory*

*B Cells, T Cells*

*Activation of the innate immune system is required to trigger adaptive immune responses.*

*Adaptive immune responses may recruit participation of cells of innate immunity (PMN, МΦ, etc).*
Humoral Immunity (HI)

Transferred by serum – mediated by antibodies

Cell-Mediated Immunity (CMI)

Not transferred by serum – mediated by T-cells (& other inflammatory cells)

Humoral immunity: protection against extracellular parasites.
Cell-mediated immunity: protection against intracellular parasites.
Defining Humoral Immunity:
resistance to pneumococcus
Antigen-specific triggering

Proliferation

Differentiation

T-cell "help"

T-cell killing: virus-infected cells, transplants

Delayed type hypersensitivity (DTH);
e.g., tuberculin reaction

Mixed Lymphocyte Reaction (MLR)

Tolerance, suppression

AGGREGATE

AUTOIMMUNITY

THREE "LIMBS" OF THE IMMUNE RESPONSE

AFFERENT CENTRAL EFFERENT

ANTIBODY T-CELL FUNCTIONS

ANTIGEN

B

AFC

T

TH2

TH1

TC

T_reg

Ag/Ab complexes

Complement

Killing of bacteria

Inflammation

Inactivation of viruses

Allergy

Complement

Antigen processing (dendritic cells, MΦ et al.)

Antigen "presentation"

Antigen-specific triggering

Antigen "presentation"
Three Limbs of the Immune Response

Ag uptake by APC
Ag Processing & Display
Ag Presentation,
... APC/T-Cell interaction
Ag-specific triggering of T and B Cells;
_Proliferation & differentiation_

**Effector functions:**
- $T_C$ – Target Cell Killing
- $T_{H1/DTH}$ – Delayed Type Hypersensitivity
- $T_{H2/B}$-cells, Ab killing/inactivation of targets
  - Complement, killing & immune complexes
- $T_{reg}$ – Suppression/regulation; Tolerance
ANTIBODY – *Binds antigen*

ANTIGEN – *Is bound by antibody*

**EPITOPE** (= “antigenic determinant”)
*Minimum target structure to which Ab binds*
ANTIGEN – Serves as *target* for immune response

IMMUNOGEN – *Elicits* immune response

<table>
<thead>
<tr>
<th>Substance</th>
<th>Mol. weight</th>
<th>Immunogen?</th>
<th>Antigen?</th>
</tr>
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<tbody>
<tr>
<td>1) BSA</td>
<td>“68,000”</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>2) DNP (free)</td>
<td>~200</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>3) DNP&lt;sub&gt;10&lt;/sub&gt;-BSA</td>
<td>“70,000”</td>
<td>BSA – yes</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DNP – yes</td>
<td></td>
</tr>
<tr>
<td>4) &quot;clarified&quot; BSA</td>
<td>68,000</td>
<td>no*</td>
<td>yes</td>
</tr>
</tbody>
</table>

* but generates tolerance

ADJUVANT – Increases immune response
Manifestations of Antibody

**Physical Effects**
- Precipitation (*soluble Ag*)
- Agglutination (*particulate Ag*)
- Binding

**Biological Effects**
- Protection
- Immobilization
- Cytolysis
- Opsonization

*Defining Property of Abs: SPECIFIC BINDING*

*..but binding by itself is invisible*
Antibody Precipitation:
The Precipitin Curve

Antigen excess

Equivalence

Antibody excess

Amount of ppt.

Amount of added Ab

See “Antibody Assays” slide show on course web site.
Manifestations of Antibody

Physical Effects
   Precipitation (*soluble Ag*)
   Agglutination (*particulate Ag*)
   Binding

Biological Effects
   Protection
   Immobilization
   Cytolysis
   Opsonization

*Defining Property of Abs: SPECIFIC BINDING*
View the Antibody Assays Slide Show on the course web site, illustrating:

Precipitation (x3)
Agglutination (x2)
ELISA
Western blot
Immunofluorescence (x2)
Serum electrophoresis
The Immune system as a defence organization

1. Its function is selective destruction.
2. It is large, complicated and elaborate.
3. It is expensive.
4. It is wasteful.
5. It has distinct components performing apparently identical functions.
6. It is slow to react.
7. It is prepared for events that never happen.
8. It fights today’s threats with the solutions of past problems.
9. It is susceptible to corruption.
10. It can destroy that which it protects.

Peter Parham, Nature 344:709 (1990)
next 4 lectures...

**T-CELL FUNCTIONS**

- **TH1**: T-cell killing: virus-infected cells, transplants
- **TH2**: T-cell "help"
- **Tc**: T-cell killing: virus-infected cells, transplants
- **Treg**: Tolerance, suppression
- **Mixed Lymphocyte Reaction (MLR)**
- **Delayed type hypersensitivity, (DTH); e.g. tuberculin reaction**

**AUTOIMMUNITY**

- Inflammation
- Killing of bacteria
- Inactivation of viruses
- Allergy

**ANTIGEN**

- **Ag/Ab complexes**
- Antigen processing (dendritic cells, MΦ et al.)
- Antigen-specific triggering
- Antigen "presentation"

**ANTIBODY**

- AFC

**AFFERENT**

- APC

**CENTRAL**

- B, Differentiation
- T, Proliferation
- TH1, TH2

**EFFERENT**

- Complement

**THREE "LIMBS" OF THE IMMUNE RESPONSE**
TOMORROW & THURSDAY

Antibody Structure I & II
Chapters 3, 4
Appendix 3-7 (Ouchterlony, Affinity Chromatography, RIA, Equilibrium Dialysis, Cross-Reactivity)