**Immune Surveillance**

The immune system is everywhere

Some organs have developed strategies towards the immune system to keep it out or to put it under control

Immune privileged organs:
- Brain
- Eye
- Testis
- Thyroid gland

**Humoral immunity**

- Complement system
- Cytokines/Chemokines
- Antibodies

**Cellular immunity**

**Soluble factors**

**Immune cells**

**Innate immunity**

- Granulocytes
- Macrophages
- Mast cells
- NK-cells

**Adoptive immunity**

- M-cells
- Dendritic cells
- Follicular DC
- T-lymphocytes
- B-lymphocytes

**Neutrophil granulocytes**

- Macrophages
  - Take up Bacteria
  - Virus
  - Dead cells
  - Destroy them in lysosomes

**Eosinophilic and basophilic Granulocytes**

- Mast cells
- NK-cells
  - Deliver substances from storage granules
  - Kill parasites or tumour cells
  - Induce or support inflammatory response

**M-cells**

- Transport antigens from lumen to lamina propria

**Dendritic cells**

- Take up antigens from their environment
- Process antigens in the lysosomal compartment
- Present antigens on MHC surface molecules to T-lymphocytes

**Follicular dendritic cells**

- Present antigen to B-lymphocytes
**B-lymphocytes**

Humoral immune response = production of antibodies

- Pre-B cell (development): Bone marrow
- B-cell priming and differentiation: Lymph follicle
- Plasma cells: antibody production in lymphatic or other tissues
- Memory B-cells: react faster to same antigen

**Function of Antibodies**

- Bind to antigenic molecules
- Neutralize toxins

**Subclasses of antibodies (immunoglobulins)**

- IgA
  - Added to secretion of glands
  - Tears
  - Nasal cavity
  - Bronchial surface
  - Gastrointestinal surface

- IgG and IgM
  - Delivered to blood and extracellular liquid

**T-lymphocytes**

Cellular immune response

- Cytotoxic T-cells (CD8+)
  - Kill virus infected cells
  - Kill tumour cells

- T-Helper cells (CD4+)
  - Produce cytokines = hormone-like soluble factors
  - Support B-cell differentiation
  - Support cytotoxic T-cell function

**Immune Surveillance**

Normal conditions
- In most tissues immune cells in low numbers

- Danger
  - Trauma/Surgery
  - Infection
  - Tumour

**Danger signals**

- Factors released by damaged cells
  - Heat shock protein 70 ↔ Toll-like receptor 4
  - Molecules derived from micro-organisms
  - Lipopolysaccharides ↔ Toll-like receptor 4
  - Toxic molecules from the environment
  - Solvents ↔ plastic dye Solvent Orange 60

**Effects of danger signals**

- Release of factors by immune and other cells
  - Chemokines, Cytokines

- Endothelial cell leakage

- Immigration of immune cells into the tissue
  - Granulocytes, Macrophages, NK-cells

- Emigration of immune cells out of the tissue
  - Dendritic cells
Immune Surveillance

Example of danger
Flu virus infection

Immune response in lymph node

Dendritic Cell – T-Lymphocyte Interaction

Activation of T-Lymphocytes

1. Feed-back
2. Proliferation of T-Lymphocytes
3. Armament of Killer Cells
4. Production of Cytokines

1. Feed-back
1. Feed-back

CD4+ T-Lymphocytes

2. Proliferation of T-Lymphocytes

3. Armament of Killer Cells

4. Production of Cytokines

Interferon-gamma

Collateral Damage

Killing of infected cells
Epithelial cell \(\rightarrow\) Reversible tissue damage \(=\) Regeneration
Nerve cells, Muscle cells, Kidney cells \(\rightarrow\) Irreversible damage
= Remaining defect
CD4+ T-Lymphocytes \(\rightarrow\) Interference with immune response
= Immune Deficiency

Harm of non-infected cells and tissues
Lung \(\rightarrow\) Thickening of air-blood barrier
Decreasing gas exchange \(\rightarrow\) Asphyxxy
Endothelial cells/capillaries \(\rightarrow\) Obstruction of blood flow
Decreasing blood flow \(\rightarrow\) Ischaemia, Stroke
Immune Surveillance

Acquired humoral immunity

- Production of specific antibodies against viruses
- Capturing of viruses before they enter the body
- Blocking of viral binding proteins
- Enhancement of phagocytosis and destruction of viruses
- Prevention of collateral damage