Immune Surveillance
by
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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

Immune Surveillance

Control of Immune System
Expression of Fas-ligand
Regulatory T-cells

Humoral immunity ↔ Cellular immunity
Soluble factors
Complement system
Cytokines/Chemokines
Antibodies

Immune Surveillance

Innate immunity ↔ Adoptive immunity
Granulocytes
Macrophages
Mast cells
NK-cells
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

T
CD4
Dendritic Cell
MHC II
TCR
CD4
IFN-γ
IL-12

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CD4
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2. Proliferation of T-Lymphocytes

3. Armament of Killer Cells
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Interferon-gamma

Collateral Damage

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

Harm of non-infected cells and tissues
- Lung: Thickening of air-blood barrier
- Decreasing gas exchange = Asphyxxy
- Endothelial cells/capillaries: Obstruction of blood flow
- Decreasing blood flow = 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

What happens when foreign antigen are present but no danger signal is present?

Activation of T-regulatory cells

Thymus derived
- CD4+/CD25+ T-lymphocytes
- Interleukin 10
- Transforming Growth Factor beta