Immunity and how Vaccines Work

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Immunity

- Resistance to infection = immunity
- *"Immunis"* = exempt
- 2 types immunity in vertebrates
  - Innate – present from birth.
  - Acquired/adaptive – result of infection or vaccination

Innate immunity

- Present from birth.
- Non-specific - acts on many organisms, no specificity.
- Not more efficient on subsequent exposure to same organisms.

Innate immunity

Non-specific host defences:

- **Mechanical / physical barriers –** skin, mucosal surfaces.

- **Prevention of stasis –** peristalsis, flow of urine, coughing, vomiting.

Innate immunity

- **Chemical defences -** Low pH stomach contents, fatty acids in skin.
- **Biological defence –** complement, lysozyme, interferons, antimicrobial peptides, kinins, adhesion molecules, hormones, lactoferrin.
- **Cellular defence** - e.g. phagocytes.

Innate immunity

Some key players in innate immunity:

1. **Complement.**
2. **Opsonization.**
3. **Phagocytosis & the oxidative burst.**
4. **Inflammation.**

Acquired immunity

- Develops as response to infection
- **“Adaptive”** - immune system adapts to previously unseen molecules
- Induction of immunity by infection / vaccination = **active immunity**

Acquired immunity

Characteristics:

- Immunological recognition.
- Discrimination between self & non-self.
- Immunological specificity.
- Immunological memory.

Acquired immunity

Immune system mounts immune response

Immune response must:

- Recognise micro-organism as foreign
- lymphocytes

- Mediate elimination of organisms

Acquired immunity.

Two types acquired immunity.

1. **Cell-mediated immunity** - **T-cells** secrete lymphokines - activate / repress immune response. (e.g. interleukin-2)

2. **Humoral immunity** - blood-specific immunity - **antibodies** (Abs)

Cell mediated immunity

- Lymphocytes - key cells in acquired immunity.
- 2 types lymphocyte develop in bone marrow.
- Following infection, lymphocytes proliferate & differentiate.

Generation of immune response.

~ 4-7 days to generate immune response.

- > 7 days get **primary immune response**
- IgM produced then IgG.
- After ~3 weeks primary response turned off
- Ab-producing cells, memory B cells formed
- Memory B cells secrete Ab when same agent encountered again.
- This is **secondary immune response**
- **Memory** lasts weeks / years.

Generation of immune response

Three types of effector immune response:

- **Humoral** - Ab response mediated by B cells, regulated by T cells.
- **Cell-mediated** - delayed-type hypersensitivity & cytotoxicity (CD4 & CD8 T cells)
- **Tolerance** - non-specific response mediated by T cells.
  - Self tolerance failure = autoimmune diseases / transplant rejection.

Inactivated Vaccines

- No chance of recreating live pathogen
- Less interference from circulating antibody than live vaccines
- Cannot replicate, thus generally not as effective as live vaccines
- Usually require 3-5 doses
- Immune response mostly antibody based

What is a Vaccine?

- biological preparation that improves immunity to a particular disease
- contains antigen(s) that resembles a disease-causing microorganism
- stimulates immune system to recognize antigen as foreign, destroy it, and "remember" it, so can recognize and destroy any of these microorganisms that it later encounters

Live Attenuated Vaccines

- Attenuated "wild" virus or bacterium
- Can replicate – immune response is more similar to natural infection
- Usually effective with one dose
- Severe reactions possible
- Can revert to a wild-type pathogen

- Fragile – must be stored carefully

How Vaccines Work