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Overview & Introduction

Immunology ⇒ lit. Protection from disease
def.: Study of structure & function of immune system

Immunity → Resistance of host to pathogens & its toxic effects
Immune response → Collected & co-ordinated response to the entry of a foreign object into the body.

Diseases brought under control due to vaccines -
Smallpox, measles, whooping cough, mumps, Tetanus, Rubella, Diphteria, Polio

Nobel Prize winning discoveries

Anaphylaxis → Life-threatening Allergic responses
Anti-histamines → suppress inflammation & allergic responses
→ Produces by a single clone of B-cell;
Monoclonal Antibodies → highly specific & can recognise only a single type of antigen

Immune Response :-

Recognition (of antigen by an immune cell) → Response (such as Phagocytosis the antigen) → (present a part of antigen, APC) → Activate Adaptive immunity

Innate immunity level: Macrophages first recognize it.

Effector Response (B cells → Plasma cells, Antibodies
T cells → cytotoxic T cells)
Eliminate / neutralize particles

B-cells differentiate into effector & memory cells
future encounter, differentiates into effector cells.

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Adaptive ↑ Innate ↑

Immunity → Humoral immunity [Antibodies, complement syst.]
→ Cell-mediated [T lymphocytes, macrophages] immunity

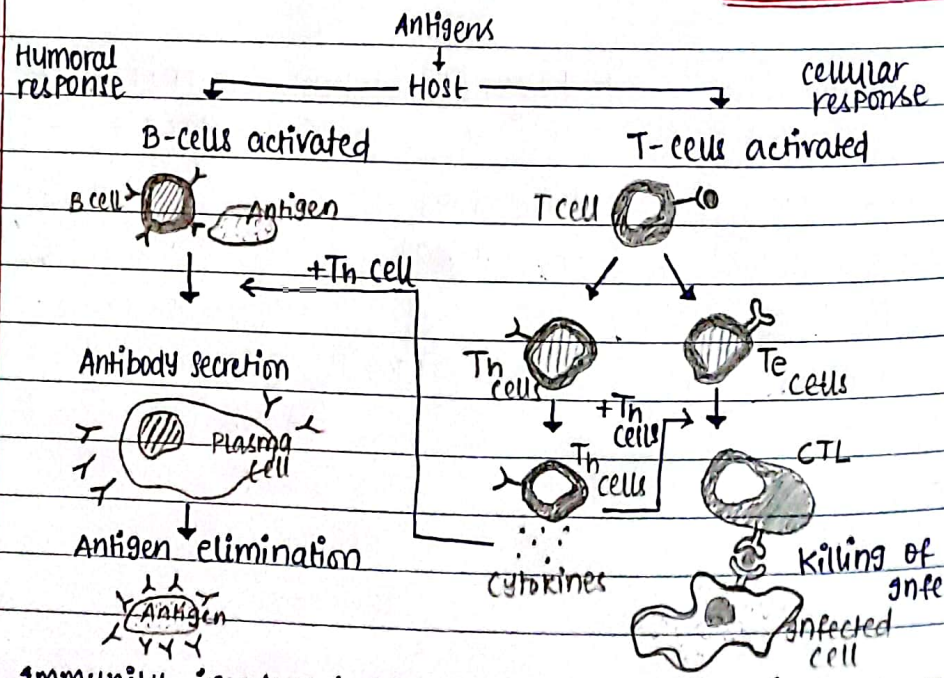
Both immunity works concurrently.

Humoral immunity:
→ soluble mediators of immunity
→ complement sys. has proteins that is soluble in blood & acts as a part of Humoral immunity.
→ main component : ~~Antigen~~ Antibodies

Cell-~~or~~ mediated immunity :
→ T-lymphocytes, macrophages [Phagocytes]
→ It can ~~it~~ activate Humoral immune response

Antigens : Bacteria, viruses, Toxins.

NOTE: B-cell receptor : can directly recognise antigen
T-cell receptor : can recognise antigen ONLY when it (x) is presented by the MHC on an APC.



Immunity involves both Humoral & cellular immune response

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Clonal selection:

Oh only the type of B and T cells undergoes proliferation, that which is specific for the antigen.

This theory is very imp: since its the basis of foundation of immunology.

1st infection → Effector cells
Proliferation of B/T cells (activated)
1st infection → Memory cells → 2nd infection → Effector cells
1st infection → Memory cells → 2nd infection → Memory cells

Reg Recognition of foreign substances—

- Pathogen associated molecular patterns (PAMPs):
  common foreign substance that characterises a whole group of Pathogens but are not present in higher organisms.
  Eg: LPS ~~in~~ on bacterial cell walls

- Pattern recognition receptors (PRRs):
  commonly present on innate immunity cells and ~~Pathoc~~ Phagocytes that recognises PAMPs.

Both Host and Pathogens are constantly evolving to outbeat the other, however, Pathogens hold an advantage that its evolves way faster due to their short life spans. Yet human immune system is no less. It has a diverse immune system ~~that's constant~~ such as the B/T cells.

The diversity arises with the help of genetic recombination event. Genetic recombination event is a random event that helps in incorporation of significant diversity in the B and T cells' receptors which can theoritically recognise any possible antigen (even if it didn't encounter one before).

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However, this genetic recomb. event is a random event. which means ~~it can that~~ there are chances that the B/T cells will recognise its self antigens and neutralise it. A counter-mechanism is the ability of cells to tolerate. Tolerance is the ability of your immune cells to distinguish b/w self & non-self cells. Upon recognition of self cells, the immune cells won't proliferate and rather undergoes apoptosis.

Any malfunction of Tolerance can result in Auto immune diseases.

Innate and Adaptive immunity :-

Innate immunity —

→ 1st line of defense

→ more than 99% of the Pathogens are blocked by our innate immunity

→ eg: skin, mucous lining the respiratory tract ~~and~~ and gut lining, eye tears, pH of stomach, Macrophages, Natural Killer cells, Antimicrobial Peptides (Defensins / Interferons), complement Proteins

Anatomical barriers

Physiological barriers

Phagocytic cells

recog. cancer & virally-infected cells

→ recognises general patterns in Pathogens ; not specific.

→ Innate immunity activates Adaptive immunity.

→ Encoded into germline. → Mostly by Dendritic cells.

Adaptive immunity —

→ Highly specific; Antibodies (part of Humoral immune response) can recognise ~~dif~~ two proteins with a ~~big~~ single Amino acid diff.

→ Unique feature : immunological memory

→ eg: B, T cells

→ Adaptive immunity develops as ~~a~~ the body gets infected.

Infection | immune response —

Initial infection → Primary immune response (4-5 days activation) → Secondary infection → Secondary immune response (immediate activation)

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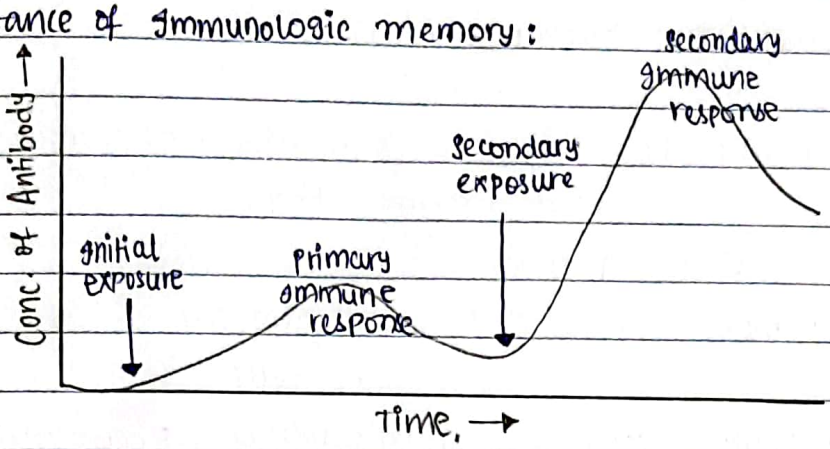
Importance of Immunologic memory:



Link b/w Innate and Adaptive immunity:

→ Dendritic cells are the most imp. for the activation of Adaptive immune response.

However, these are other Professional Antigen presenting cells.

→ Professional APCs include –

- Dendritic cells
- Macrophages
- B cells

→ In fact, any cell that can present an antigen on its surface it can be called as an APC.

Comparison b/w innate and adaptive immunity

	Innate	Adaptive
Response time	Hours	Days
Specificity	Limited and fixed	Highly diverse, improves during course of immune response
Response to repeat infection	Identical to primary response	much more rapid than primary response
Major components	Barriers, Phagocytes, Pattern recognition molecules	Lymphocytes, Antigen-specific receptors, antibodies

Phases of immune response –

Innate immune response → Adaptive immune response → Immunological memory

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Dysfunctional immune response –

* Hypersensitivity: overly zealous attacks on common benign but foreign antigens

eg- Alergies, Asthma

* Autoimmune disease: Erroneous targeting of self proteins or tissues by the immune cells

eg- Multiple sclerosis, crohn's disease, Rheumatoid arthritis

* Immune deficiency: Insufficiency of the immune response against infections agents

eg- Severe combined immunodeficiency syndrome (SCID), Acquired immunodeficiency syndrome (AIDS)

Levels of defense:

Anatomic Barriers

Skin, oral mucosa, respiratory epithelium, intestine

↓

Complement / antimicrobial Proteins

C3, defensins, Reg III γ

↓

Innate immune cells

Macrophages, Granulocytes, Natural Killer cells

↓

Adaptive immunity

B cells / Antibodies, T cells