IMMUNOLOGY

INFLAMMATION

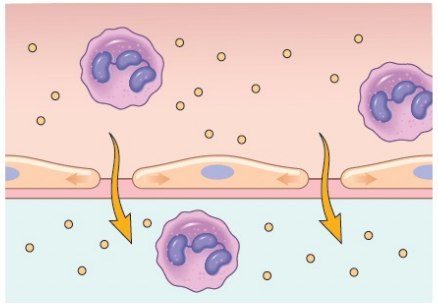
1. transient vc

VASODILATION (2)

Increased permeability (3)

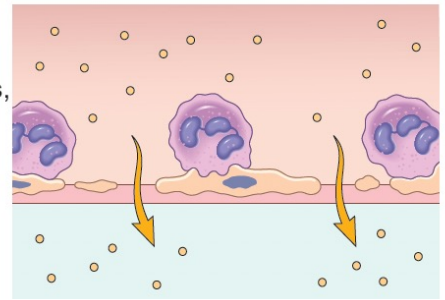
RETRACTION OF ENDOTHELIAL CELLS aa

- Induced by histamine, other mediators
- Rapid and short-lived (minutes)



ENDOTHELIAL INJURY

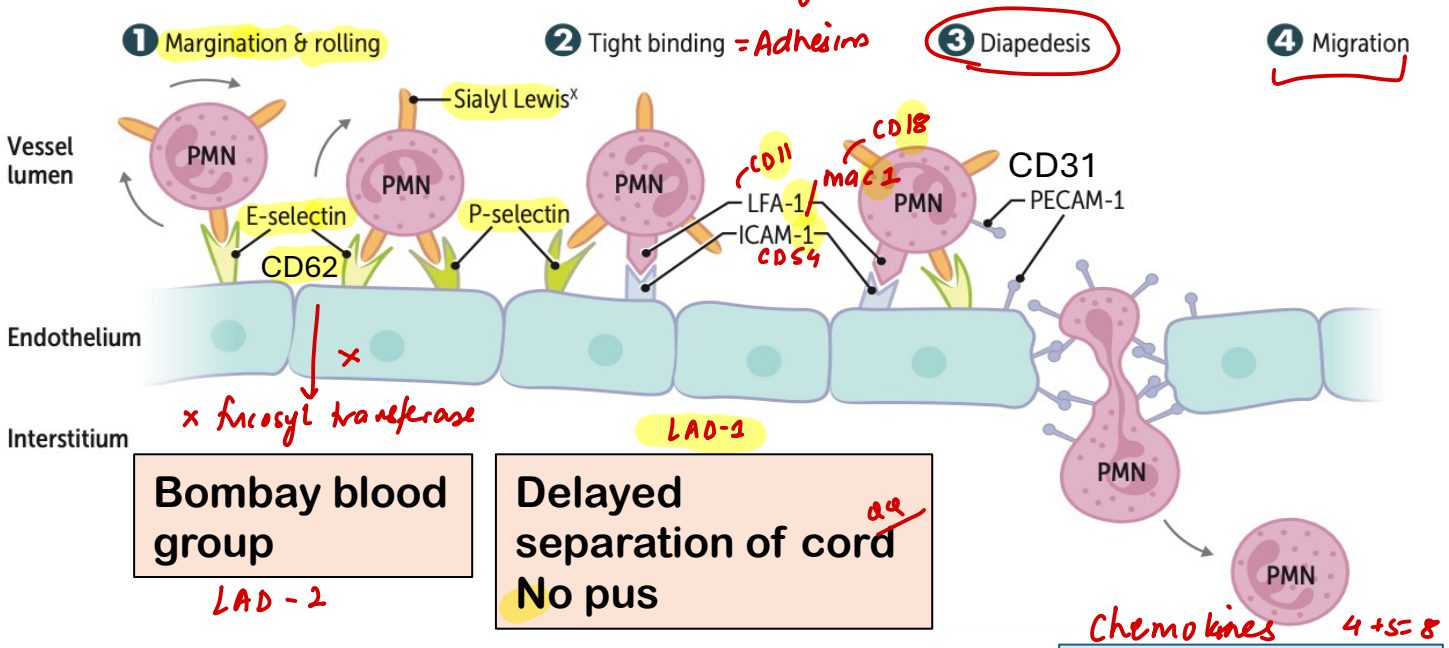
- Caused by thermal burns, some microbial toxins
- Rapid; may be long-lived (hours to days)



EXTRAVASATION

Site: post capillary venules

Steps of inflamm aa



Bombay blood group

LAD - 2

Delayed separation of cord aa
No pus

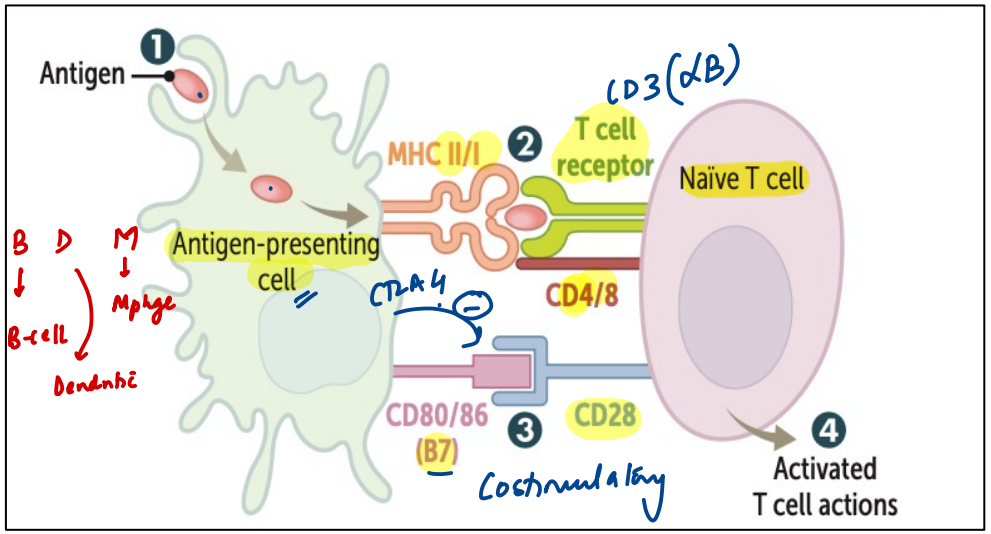
Chemokines 4+s=8

IL-8, C5a, LTB4, 5HETE, Kallikrein

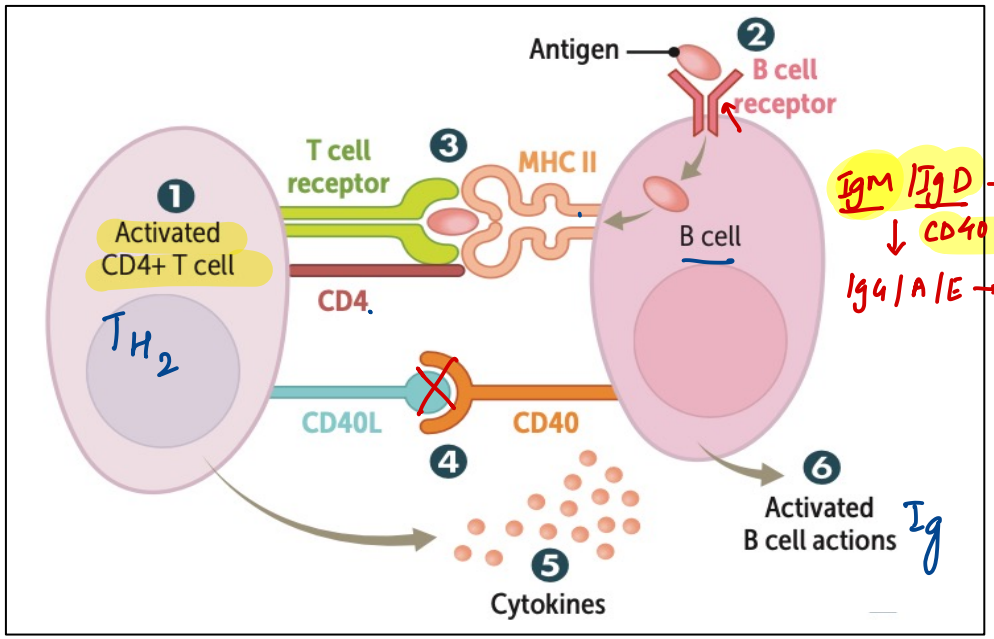
C X C

Chemokine family	Examples
CXC chemokines (α) aa	IL-8 → Neutrophils
CC chemokines (β)	Eotaxin → Eosinophils MCP-1 /RANTES → Monocytes / Macrophages
C chemokines (γ)	Lymphocytes
CX3C chemokines (δ)	Fractalkine-Monocytes and T-cells

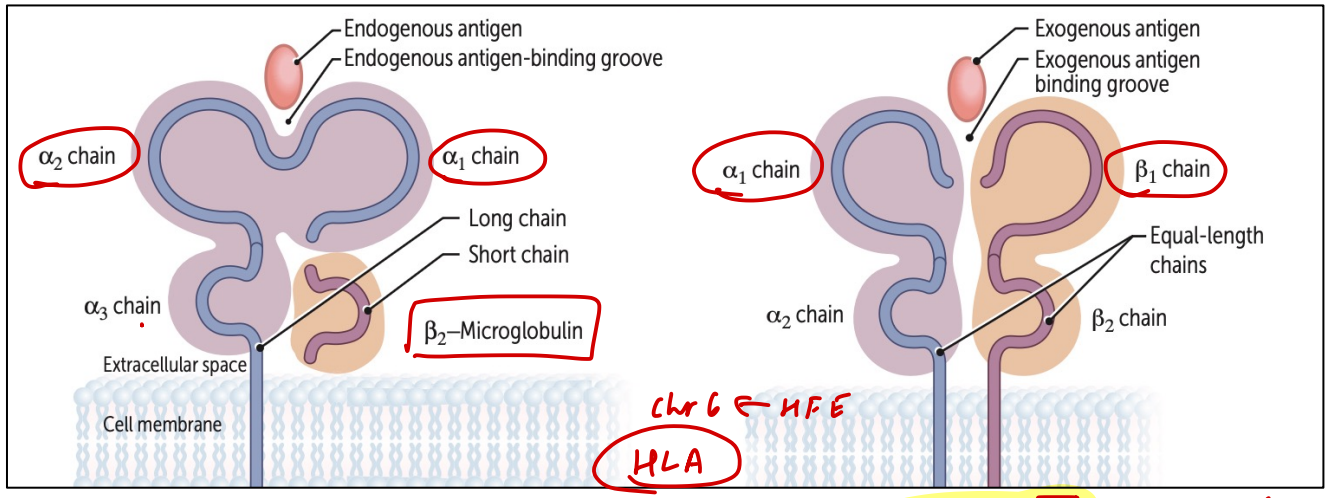
Baby-steps in immunology!



B D → B-cell → Dendritic
M → Mφ/g



IgM / IgD → 1° response
↓
CD40 – CD40L
↓
IgG / A / E → 2° response
↑↑ specific



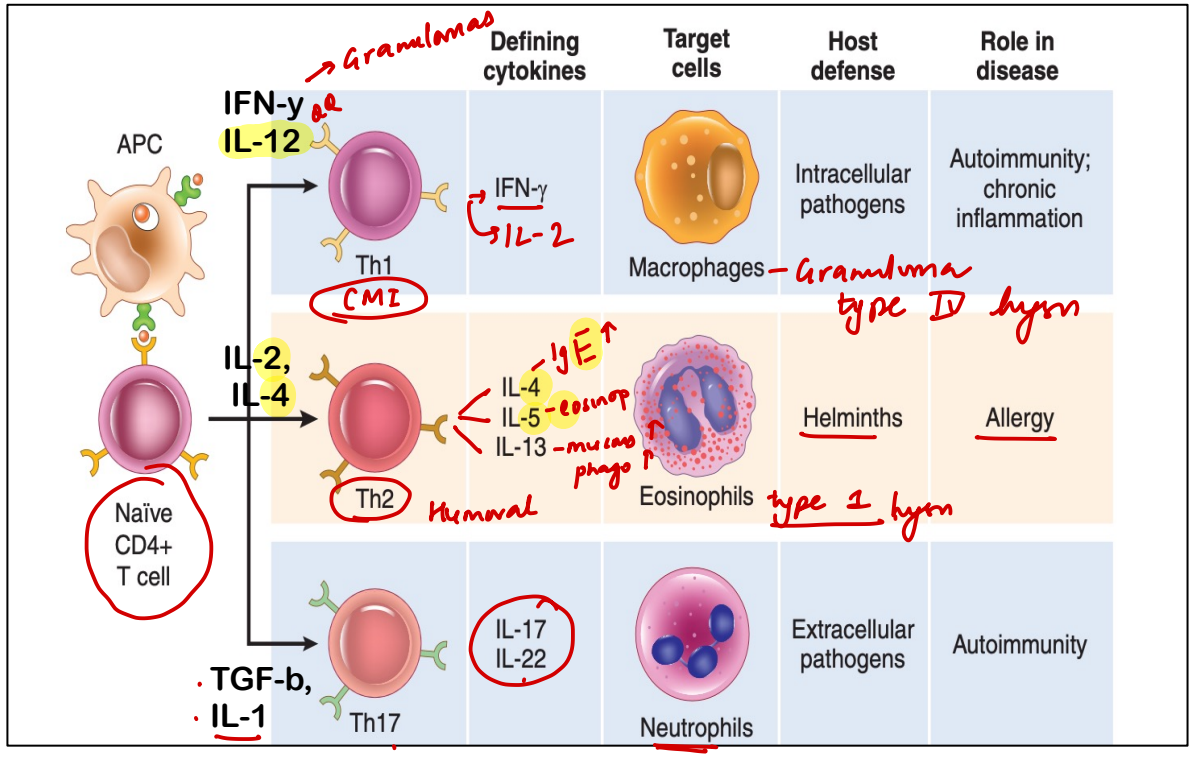
chr 6 ← HFE
HLA

MHC I – HLA A/B/C
↓
. all nucleated cells
. plt
⊗ < sperms
< RBCs
↓
- CD8 cytotoxic Tcells
- Intracellular Ag.-infected

Rule of 8

MHC II – HLA DP/DQ/DR
↓
APC
↓
. CD4 Helper TH
. exogenous Ag.

TH
TH1 → CMI
TH2 → Humoral → B-cell → Plasma cell
TH17 → ↑ Neutrophil



1L-2, IL-12, INF-G: TH_1 → CMI

IL-4, IL-5, IL-13: TH_2 → Humoral.

IL-1, IL-6, TNF-A: PYROGENS

1L-10, TGF-B, Lipoxin: Anti-inflamm

C3b, IgG: OPSONINS - encapsulated - SHEN → phagocytosis

C3a, c5a: anaphylatoxins

Treg cells: Peripheral immune tolerance

Induced by: TGF-β/ IL-2

Shimon Sakaguchi, Fred Ramsdell, and Mary Brunkow - Nobel Prize 2025

IPEX (Immune dysregulation, Polyendocrinopathy, Enteropathy, X-linked) syndrome : FOXP3 defect

Positive selection: Tcells – MHC (react =)

Negative selection: Tcells – too strongly self-MHC – xx

AIRE in thymus: negative

- AIPS-1 → mucocut candidiasis / ectodermal dysplasia ↓PTH / Addison / Graves'
- AIPS-2 → Addison / type 1 DM / Hashimoto's

IL-12 receptor defect (AR)-Mendelian Susceptibility to Mycobacterial Disease (MSMD)

GRANULOMAS

mphgs activated = epithelioid cells ← lymphocytes

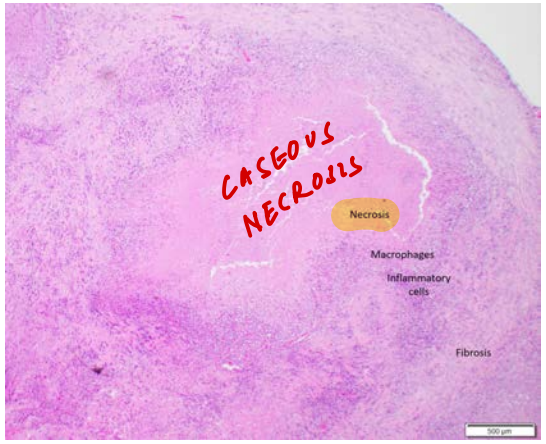
GRANULOMAS:
Caseating- TB / Histoplasma / coccidio
Non-caseating- Sarcoidosis / CD
Histiocytes in gumma- Leprosy.
Stellate- Cat scratch D → B. henselae
Durck- Malaria
Doughnut- Allopurinol / Q Fever = Coxiella

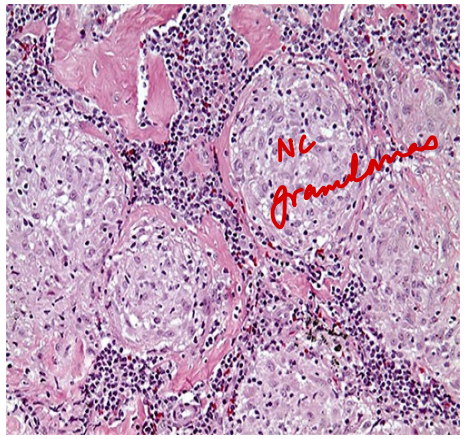
Granulomatous D

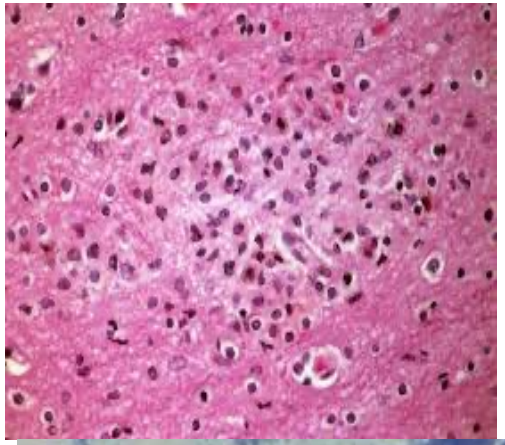
Listeria/ Schistosomiasis
CGD
PBC
GPA, EGPA, Takayasu / GCA
De Quervian thyroiditis
Berylliosis, HSP, Talcosis

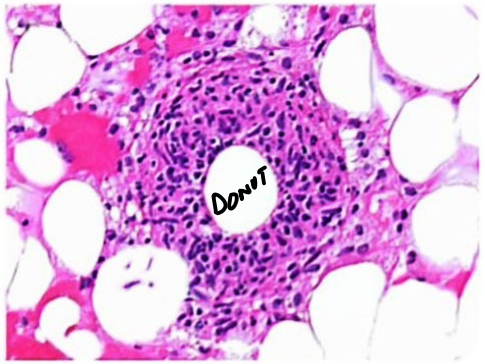
Type IV > III

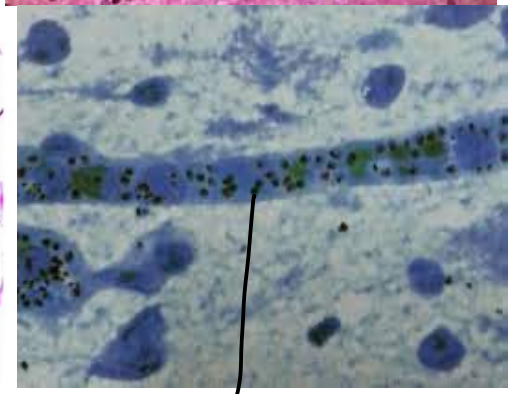
"FB granuloma"











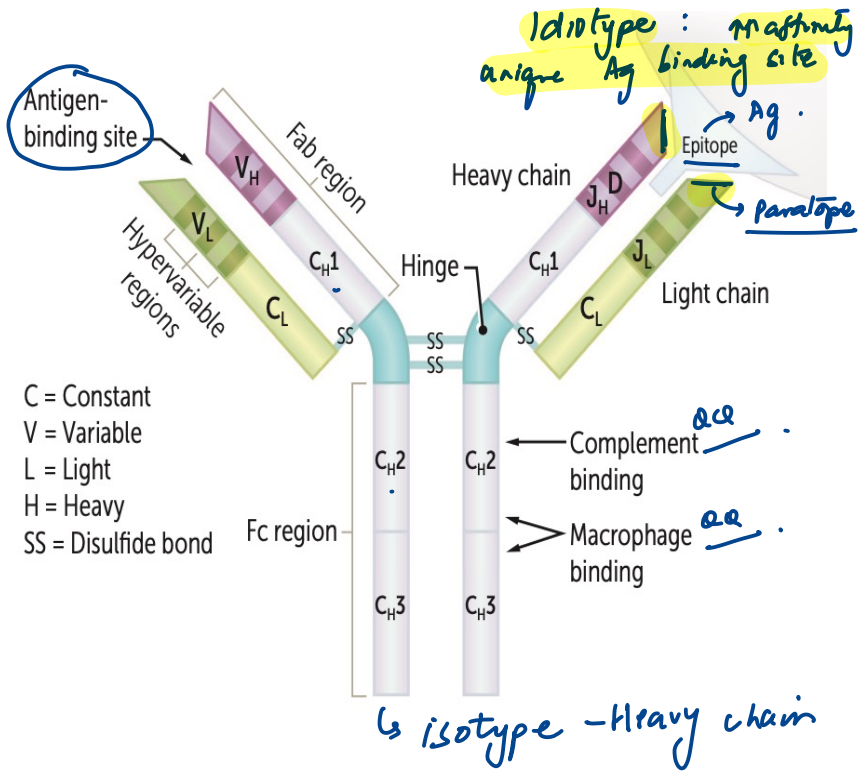
Field stain
Dusk granuloma

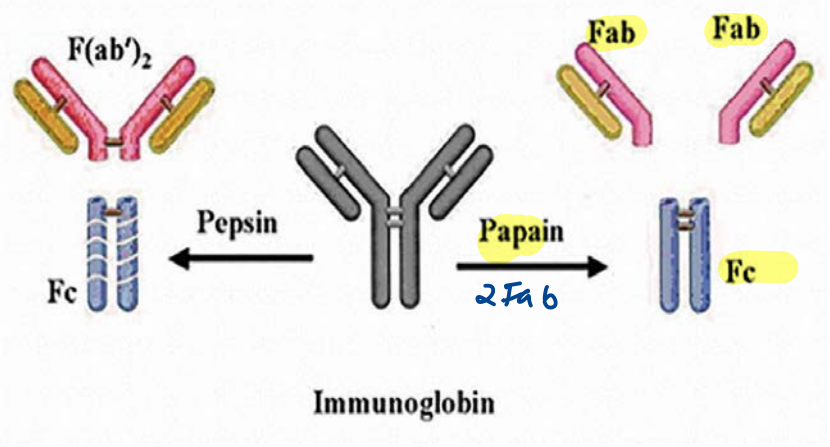
Immunoglobulins

Affinity maturation-Somatic hypermutation
Isotype switching-Alternate RNA splicing
Hyper IgM disease

Generation of antibody diversity
1. Random recombination of VJ (light-chain) or V(D)J (heavy-chain) genes by RAG1/2
2. Random addition of nucleotides to DNA during recombination by TdT
3. Random combination of heavy chains with light chains

Ig Type	Half-life	Key Features
IgG	23 days	- Appears late → chronic infection - Only Ig to cross placenta - Opsonization, complement fixation, neutralization
IgA	6 days	- Two types: Serum IgA & Secretory IgA (dimer) - Secretory IgA → mucosal immunity
IgM	5 days	- Pentamer, highest molecular weight - Appears early → recent infection - Intravascular only - Agglutination, hemolysis, opsonization
IgD	2–8 days	- Surface Ig on B cells - Acts as antigen recognition receptor
IgE	1–5 days	- Type I hypersensitivity - Heat-labile





Miscellaneous

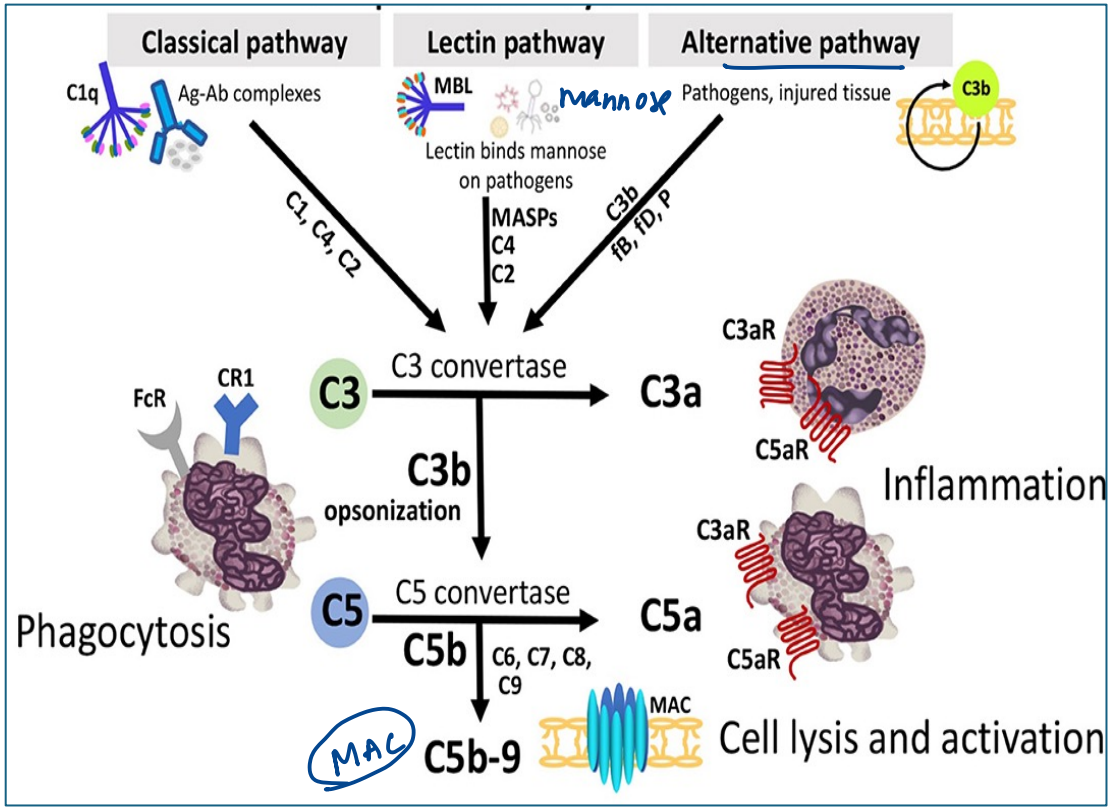
Primary: Bone marrow, Thymus
- Lymphocyte formation and development

Secondary: Spleen, Lymph node, Peyer's patches, Tonsils
- Lymphocyte activation and proliferation

MC complement deficiency: C2
Early complement deficiency: SLE
Terminal comp /MAC def: qq Disseminated Neisseria qq

T cell receptor: Gamma-delta:

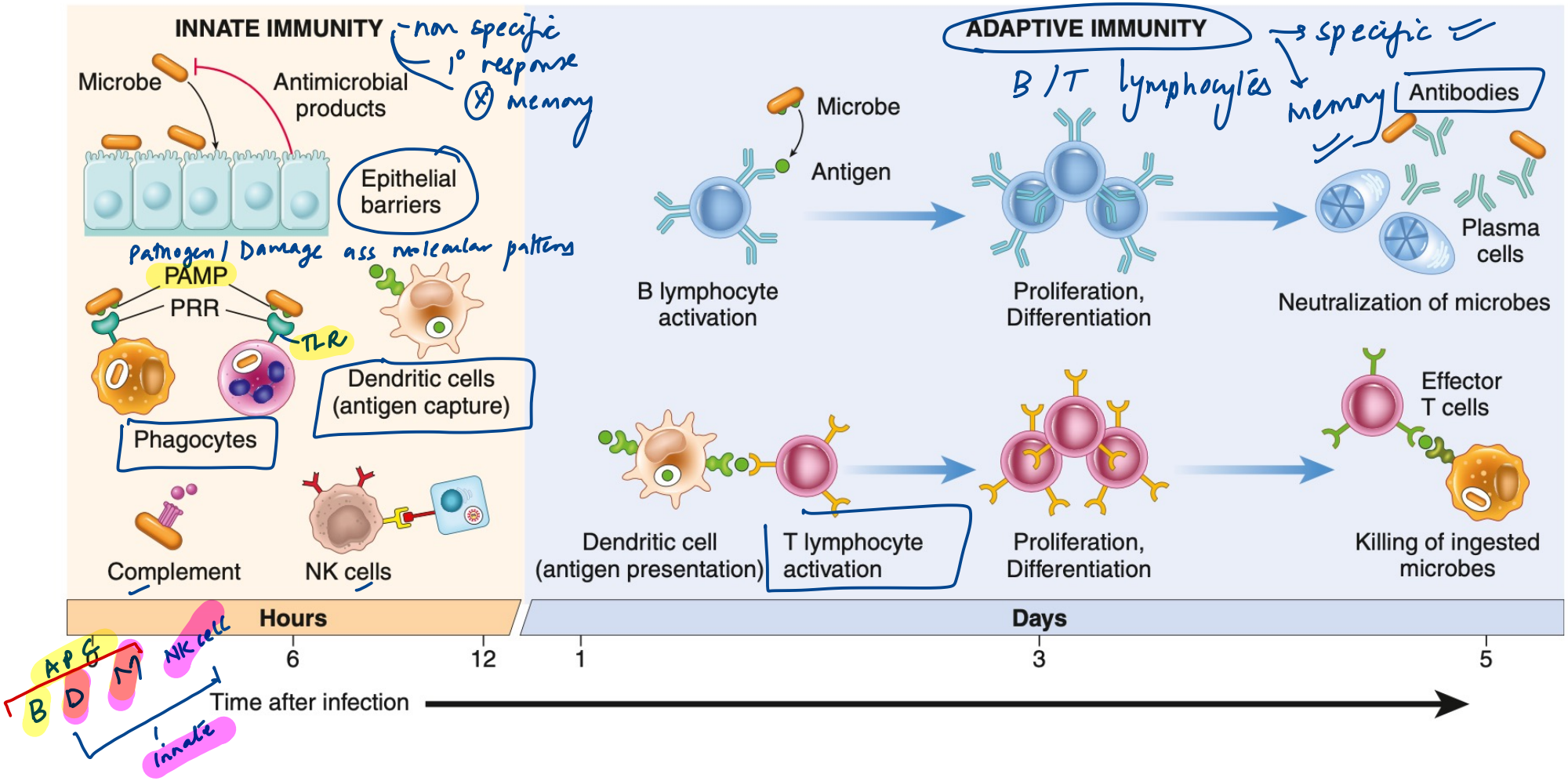
- 5% T cells
- Innate Immunity
- GI / GU
- MHC - unrestricted



- C1-esterase inhibitor prevents cleavage of C2 and C4
- DAF (CD55) prevents formation of C3 convertase
- MIRL (CD59) prevents formation of MAC

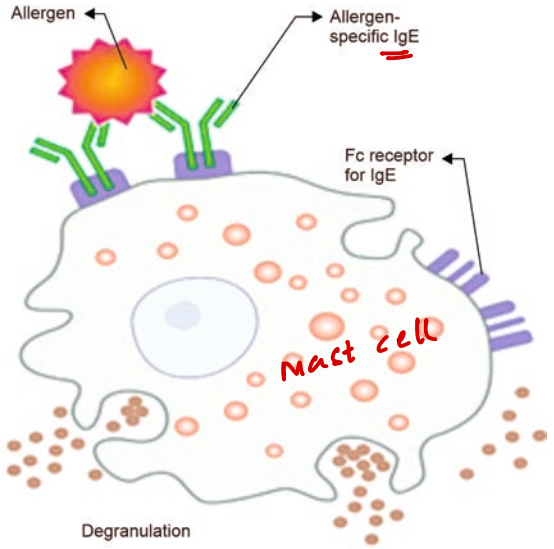
} PNH

× HAE - AD → ↓C2 ↓C4 → Bradykinin ↑



PAMPs: LPS (GNB)- TLR4, flagellin, nucleic acids (viruses)-RIG-1
DAMPs: mitochondrial DNA, histones, heat shock proteins

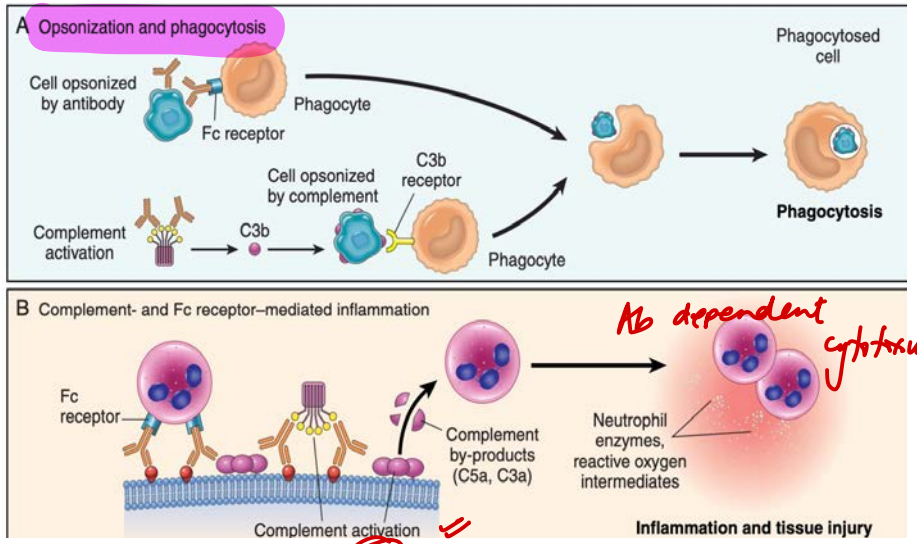
Hypersensitivity Reactions



mast cell

type I

- asthma
- atopy
- Casoni rxn QQ
  ↳ Hydatid



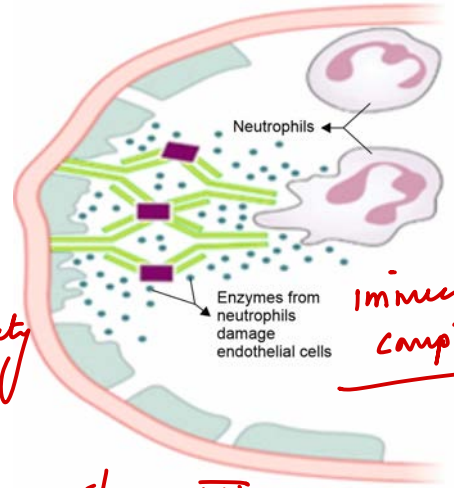
Ab dependent cytotoxicity

Type II = Ab

- Autoimmune hemolytic anemia DCT
- Immune thrombocytopenia GpIIb-IIIa
- Transfusion reactions ABO
- Hemolytic disease of the newborn Rh
- Good pasture syndrome anti-GBM
- Rheumatic fever QQ
- Hyperacute transplant rejection / Acute humoral
- Pemphigus Dsg

type IV

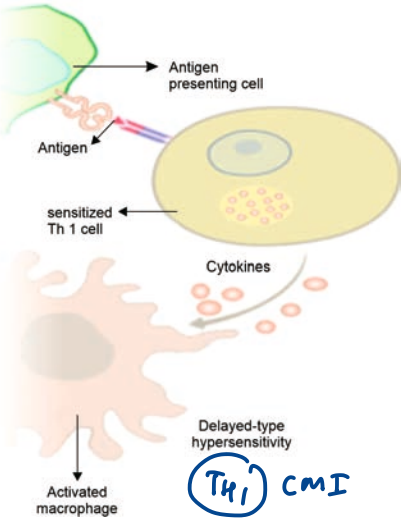
- Myasthenia gravis Ach-R
- Graves disease TSH-R



immune complex

type III

- Serum sickness, Arthus reaction
- HSP/ IgA vasculitis 'HSP-C'
- SLE (type III > II)
- Polyarteritis nodosa
- Cryoglubulinemia
- PSGN QQ
- Rheumatoid arthritis
  Reactive arthritis
- Hypersensitivity pneumonitis (type IV > III)
- Shick test
  ↳ Diphtheria



TH1 CMI granulomas.

type IV

- Contact dermatitis
- Graft-versus-host disease
- PPD for TB infection
- Patch test
- Lepromin test
- Montenegro test Kala azar
- Transplant rejection-
  Chronic / Acute cellular

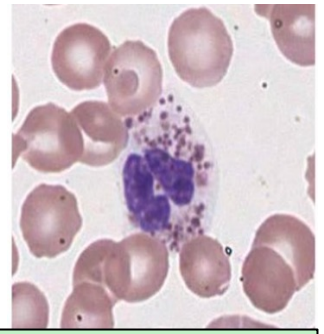
Immunodeficiency disorders

Wis "cute" - Aldrich

- Thrombocytopenia
- Infections
- Eczema- High IgE
- WASP
- XLR

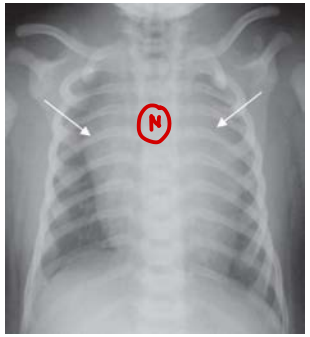
- Facies — S.aureus
- Abscess-Cold
- Teeth
- Eczema-IgE high

Job's Sx — TH17 — Hyper-IgE



- Lyst, Light — Chediak - Higashi
- Microtubule
- Neurodegeneration
- phagOlysosome
- Platelet, Neutrophil dense granules

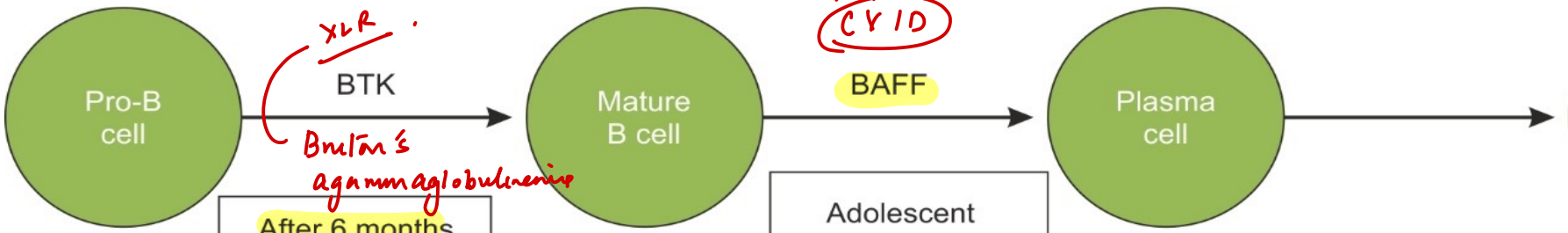
- Recurrent infections since Birth
- IL-2R: XLR (mc) — SCID
- ADA : AR
- Absent germinal centers/ thymus
- TRECs (T-cell receptor excision circles) - Screening



- Absence of MHC class I / II on lymphocyte:

Bare lymphocyte.

T cell - Birth
B cell - ≥6mon



After 6 months
- Absent Ig-all
- Absent germinal centers/tonsils

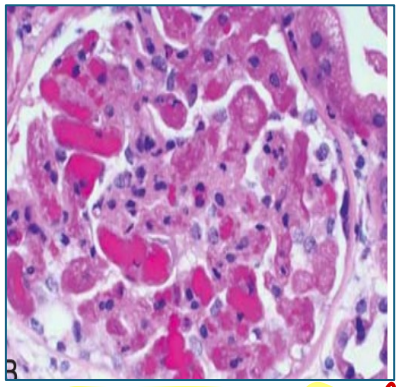
Adolescent
- Low Ig-all
- Hyperplastic germinal centers

- Giardiasis +
- Anaphylaxis - BT

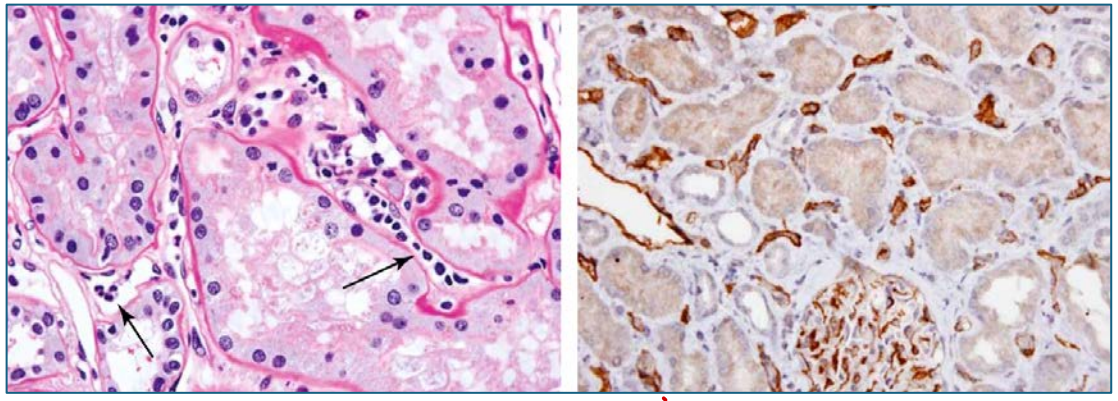
D/D - Diarrhoea Sx - 22q del
- 3rd/4th ph pouch
- Tcell + ↓Ca2+

- Celiac D — false -ve
- IgA-TTG

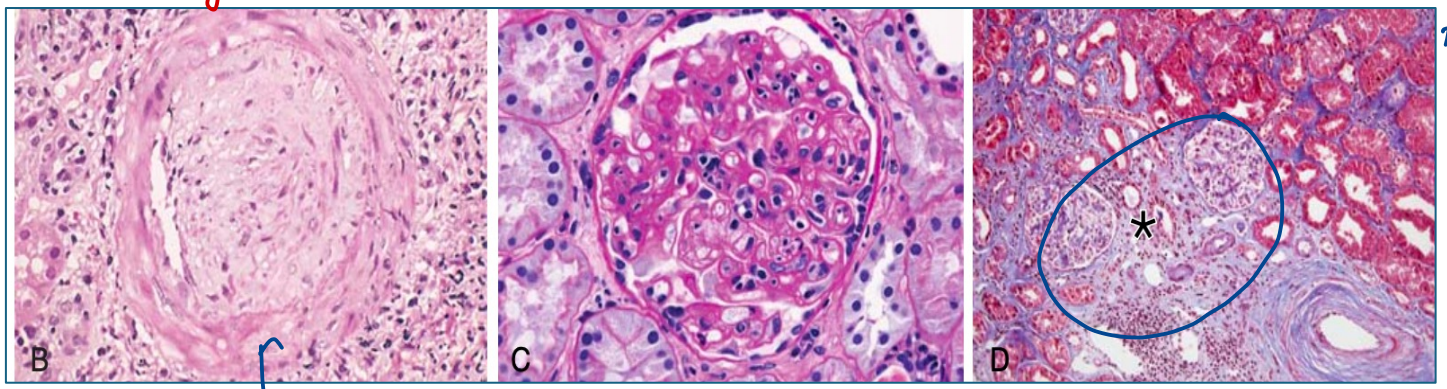
Transplant immunology



Hyperacute rejection (type II hyper) prior BT
preformed Ab < multiparity
"mottled / cyanosis" on table



Acute rejec n 6m
type II hyper = Humoral → C4d
type IV hyper = cellular
tubulitis
endotheliitis



arteriosclerosis

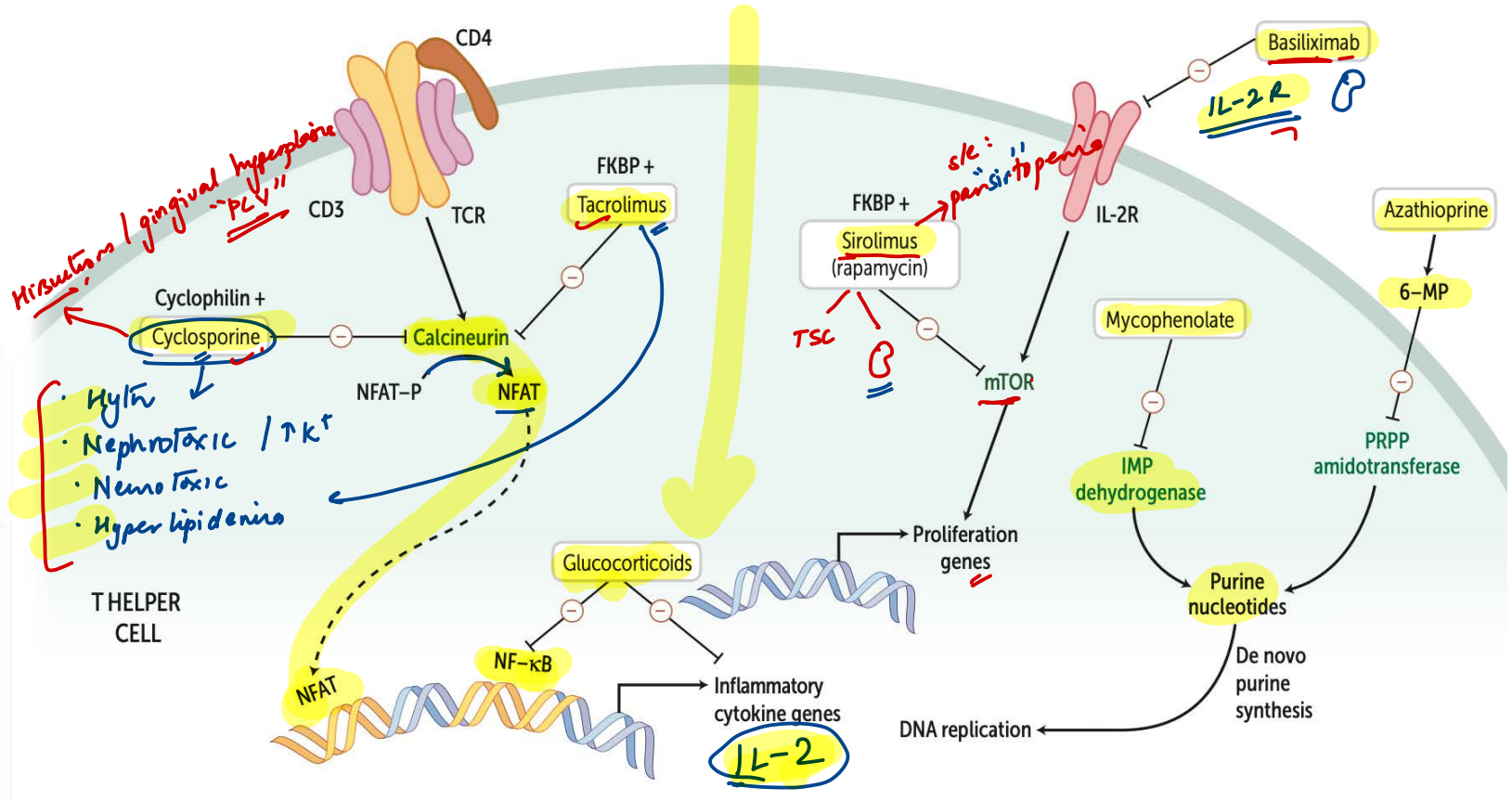
CHRONIC REJEC" = CMI / type IV hyper

G A T I — Interstitial fibrosis
G — GBM thickening duplic"
A — Arteriosclerosis
T — Tubular atrophy

Prevent:
- Immunosupressin
- HLA matching

Autograft: self
Isograft: identical twin
Allograft/ Homograft: same species
Xenograft/ Heterograft: diff species
Most important HLA: HLA-DR.
⊗ need: corneal aR / ♡ / lung
MC infection (1-3month) post transplant: CMV ← immunosupressive
GVHD: donor Tcells → attack recipient.
100d - Acute
Skin / Rash
liver / Jaundice
GIT / diarrhea
Graft VS Leukemia effect:
HSCT - donor Tcells → Recipient leukemia cells.
HSCT max
Max solid organ transplant with GVHD: SI (peyer patches)

IMMUNO-SUPRESSANTS



IMMUNE CHECK POINT INHIBITORS

Advanced melanoma, RCC

- Melanoma
- HL
- NSCLL
- UB
- Merkel cell ca