



Basic Immunology Lecture - 1

Kidney Dialysis Techniques Department

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1 / 2 / 2026



Cells of the Immune System

Structure, Function & Clinical Relevance in Dialysis Patients

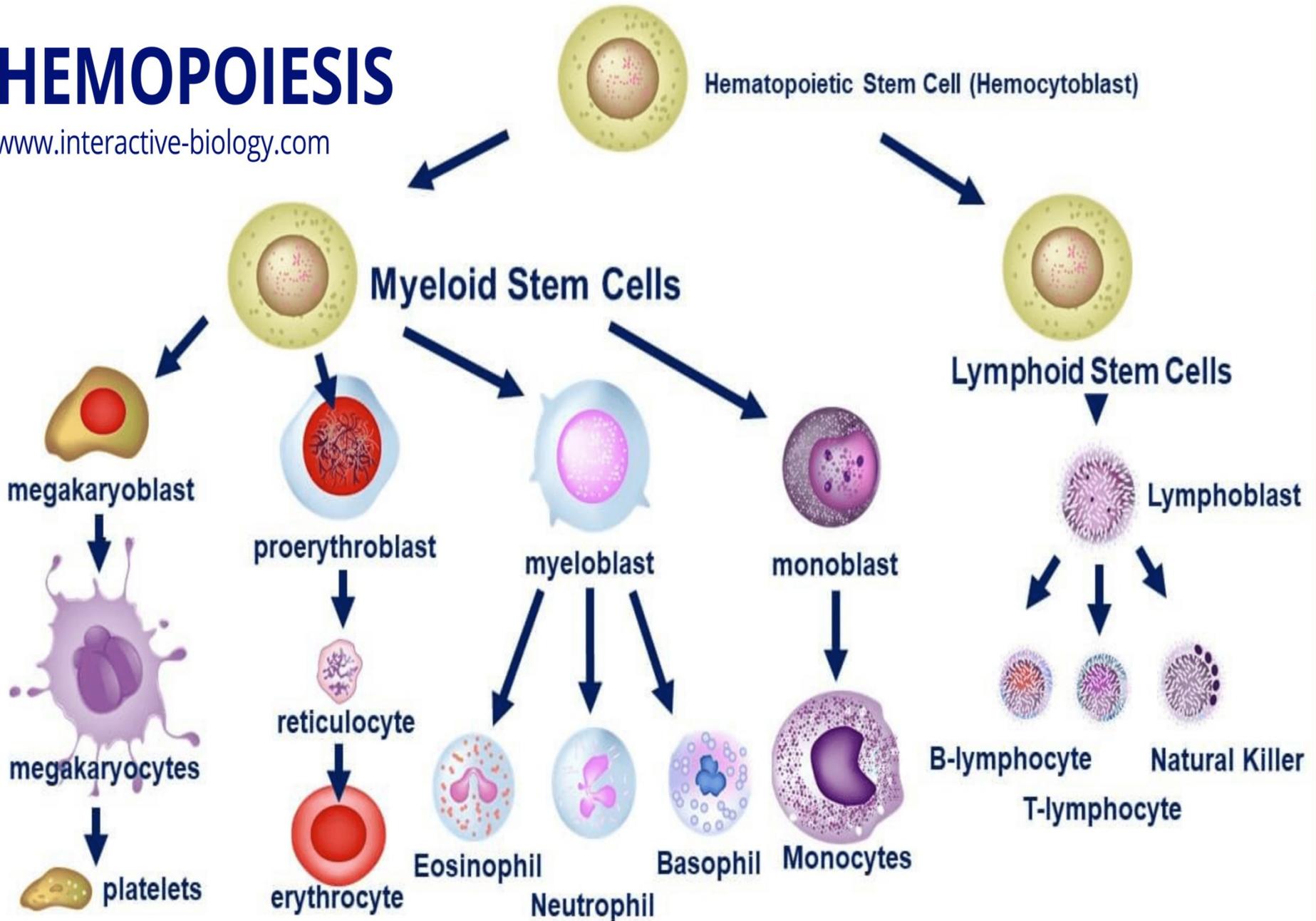
Learning Objectives

By the end of this lecture, students will be able to:

- 1- Identify major immune cell types and their origins.**
- 2- Explain innate vs. adaptive immunity.**
- 3- Describe roles of key cells: Neutrophils, Macrophages, Dendritic Cells, T & B Lymphocytes.**
- 4- Relate immune dysfunction to dialysis complications (infections, inflammation, rejection).**
- 5- Understand vaccination & immunosuppression in ESRD patients.**

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- ▶ **Why Should Dialysis Technicians Care About Immune Cells?**
- ▶ **Clinical Relevance**
- ▶ **ESRD patients = immunocompromised → high infection risk (catheter, access site, sepsis)**
- ▶ **Chronic inflammation → cardiovascular disease & amyloidosis**
- ▶ **Pre-transplant evaluation → HLA matching, immunosuppression**
- ▶ **Vaccine response is often impaired → need for higher doses or adjuvants**

Signs and Symptoms of End-Stage Renal Disease (ESRD)

Weight loss

Weakness and fatigue

Muscle cramps and swelling

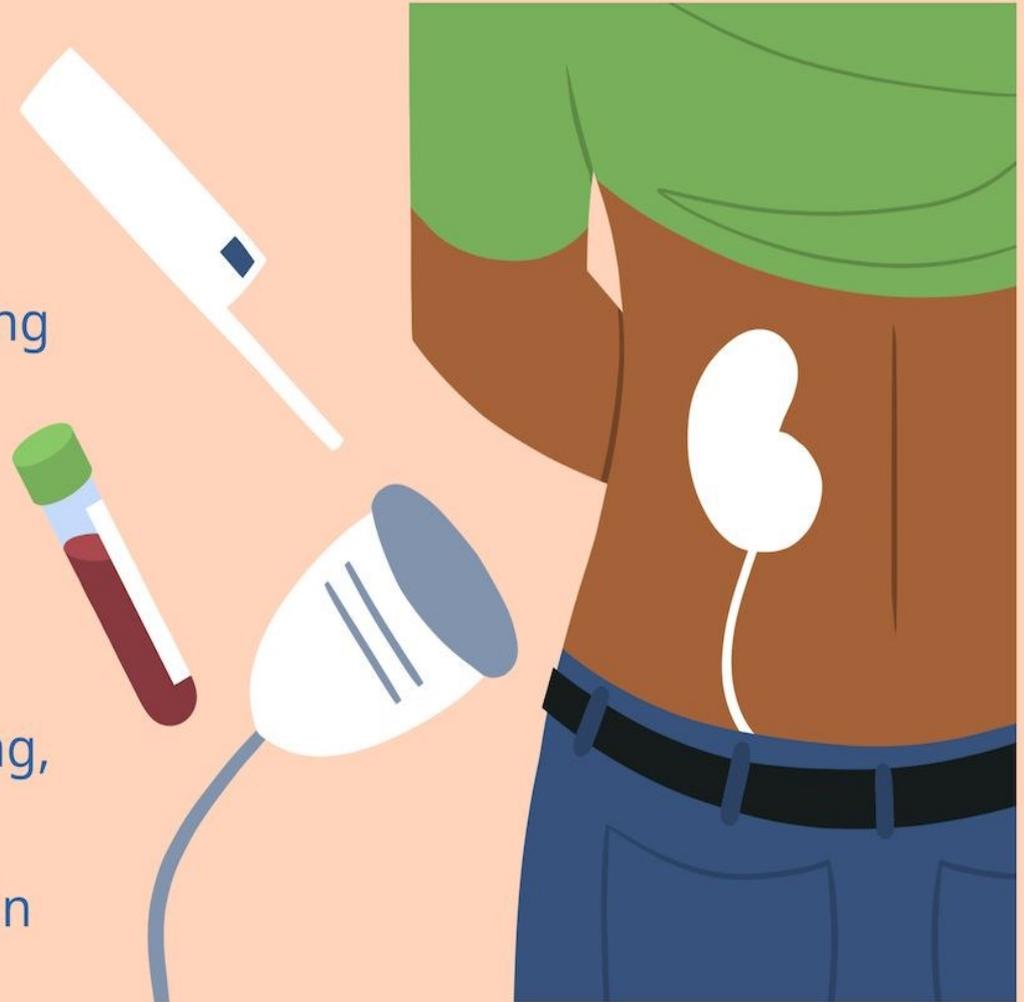
Easily bruising

Peripheral neuropathy

Trouble concentrating

Reduced appetite, vomiting,
and extreme thirst

Abnormal light or dark skin



Overview of the Immune System

Two Main Branches

🌀 **Innate Immunity – Immediate, non-specific (barriers, phagocytes, complement)**

🌀 **Adaptive Immunity – Delayed, specific, memory (T & B cells)**

Key Organs:

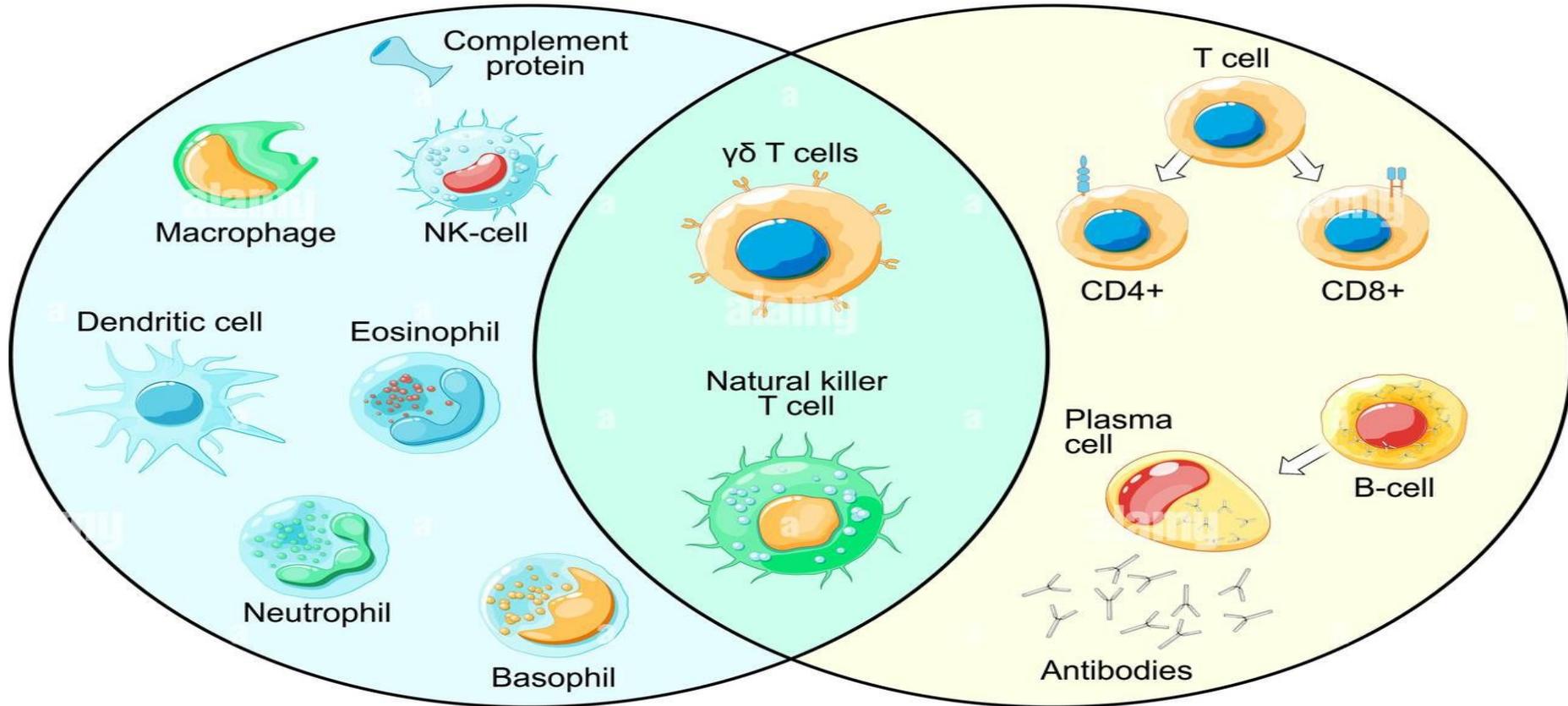
♣ **Bone marrow, Thymus, Spleen, Lymph nodes, MALT**

- **Image Suggestion: Diagram showing innate vs adaptive immunity pathways.**

The Immune Response

Rapid response

Slow response



INNATE
IMMUNITY

ADAPTIVE
IMMUNITY

Hematopoiesis – Origin of Immune Cells

All immune cells derive from:

→ Hematopoietic Stem Cells (HSCs) in bone marrow

▶ Two Lineages

Myeloid Lineage: Neutrophils, Monocytes, Eosinophils, Basophils, Dendritic Cells

Lymphoid Lineage: T cells, B cells, NK cells

Cells of Innate Immunity (Part 1)

1- Neutrophils

Most abundant WBC

First responders to bacterial infection

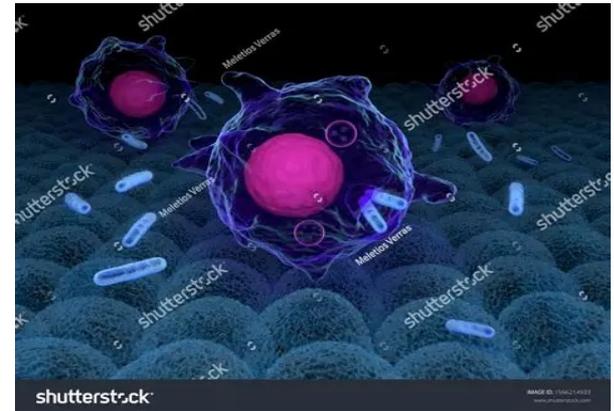
Phagocytosis + NETs (Neutrophil Extracellular Traps)

2- Macrophages

Tissue-resident phagocytes

Antigen presentation + cytokine release

Play role in chronic inflammation in ESRD



Cells of Innate Immunity (Part 2)

3- Dendritic Cells

- ▶ “Professional” antigen-presenting cells (APCs)**
- ▶ Bridge between innate & adaptive immunity**
- ▶ Critical for vaccine response**
- ▶ Natural Killer (NK) Cells**

4- Kill virus-infected & tumor cells

No prior sensitization needed

Cells of Adaptive Immunity – T Lymphocytes

▶ Develop in Thymus → Mature in Lymphoid Organs

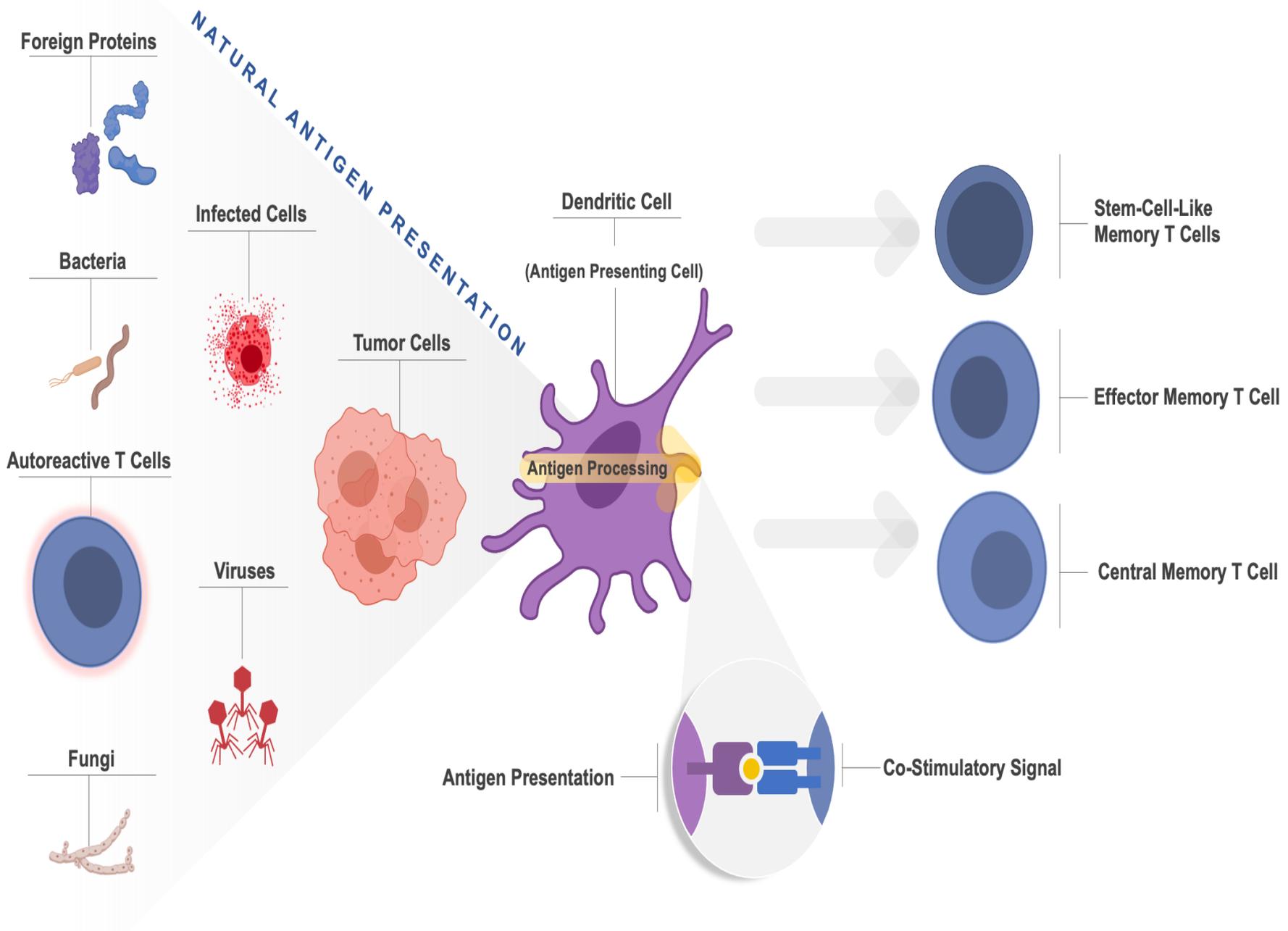
Types:

▶ Helper T (CD4+) → Activate B cells, macrophages, other T cells

▶ Cytotoxic T (CD8+) → Kill infected/cancer cells

▶ Regulatory T (Treg) → Suppress immune response (prevent autoimmunity).

▶ ▶ In Dialysis: CD4+ counts often low → increased infection risk



Cells of Adaptive Immunity – **B Lymphocytes**

 **Develop & Mature in Bone Marrow**

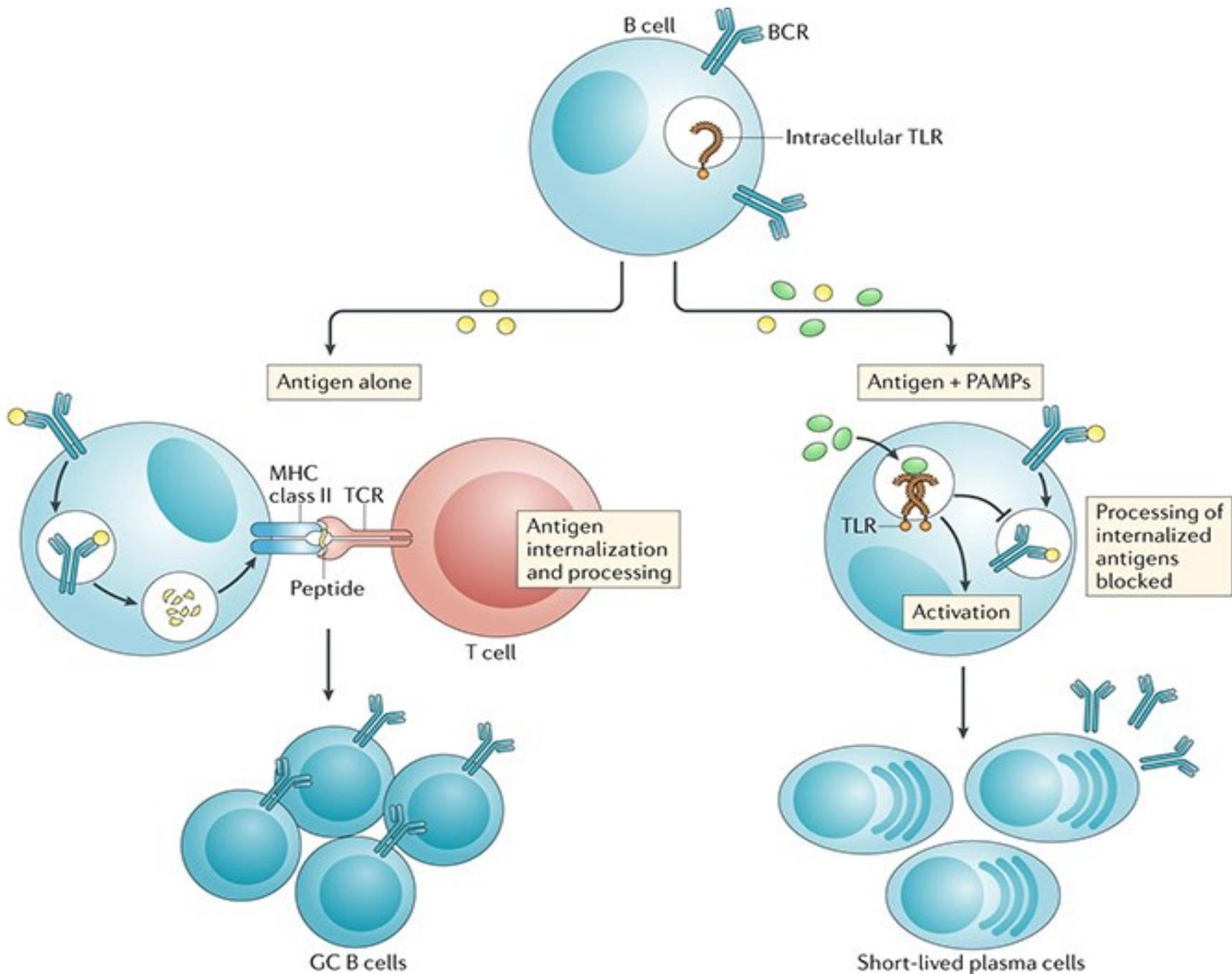
Functions:

 **Produce antibodies (Immunoglobulins).**

 **Differentiate into Plasma Cells (antibody factories) & Memory B cells**

  **Antibody Classes: IgG, IgM, IgA, IgE, IgD**

 **→IgG most important for long-term immunity**



Antigen-Presenting Cells (APCs) – The “Generals”

Include:

♠ **Dendritic Cells (most potent)**

♠ **Macrophages**

♠ **B cells**

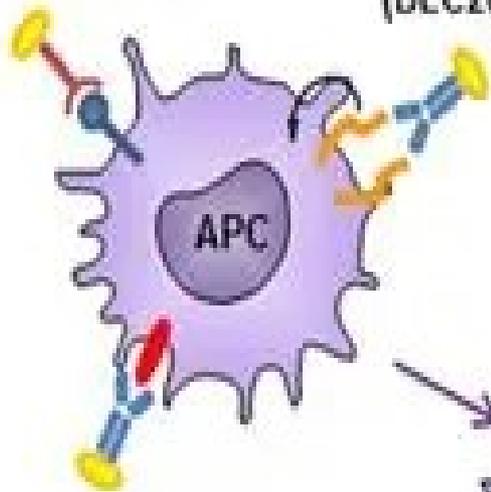
Function :

▶ **Capture, process, and present antigens to T cells via MHC molecules**

▶ **Essential for initiating adaptive immune response**

antigen linked
to APC-specific ligands
(CD40L, chemokines...)

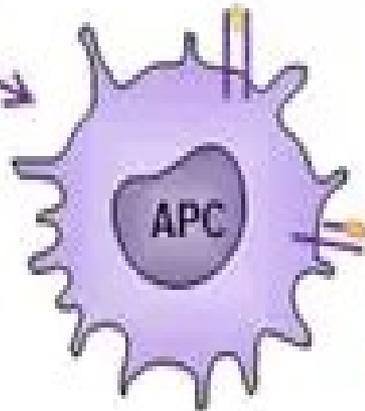
antigen linked
to internalizing receptors
(DEC205, CD36, mannose
receptor...)



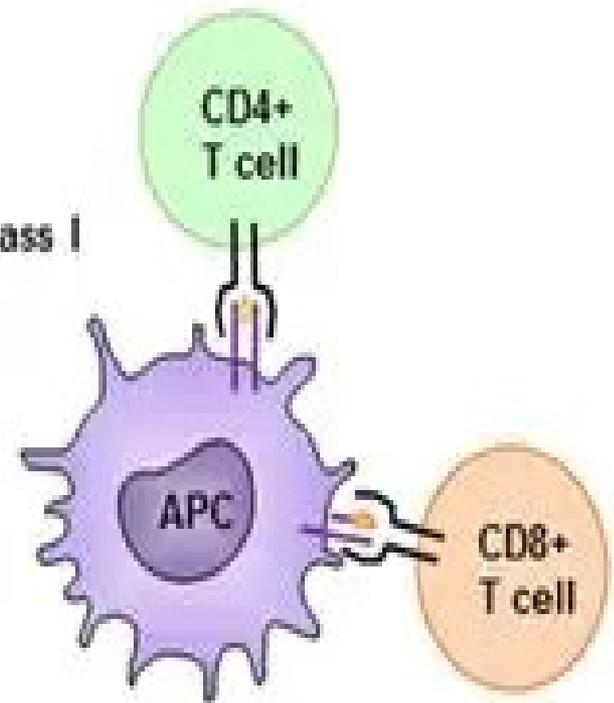
antigen linked to
APC-restricted molecules
(CD19, MHC class II)

1. Antigen targeting

MHC class II



MHC class I



2. Antigen processing and presentation

3. T cell activation

Immune Dysfunction in ESRD & Dialysis Patients

Key Problems:

- ▶ **“Immunoparalysis” – Reduced neutrophil/macrophage function**
- ▶ **Chronic inflammation – Elevated IL-6, CRP → CVD, malnutrition**
- ▶ **Impaired vaccine response – e.g., Hepatitis B, Influenza, COVID-19**
- ▶ **Uremic toxins suppress immune cell activity**

Infections in Dialysis – Immune Cell Connection

Common Infections:

- Catheter-related bloodstream infections (Coagulase-negative Staph)
- Access site infections
- Pneumonia, UTI

Why?

- Impaired neutrophil chemotaxis & phagocytosis
- Low complement activity
- Skin barrier disruption + frequent vascular access

Immunosuppression & Kidney Transplantation

Pre-Transplant:

Immunosuppression & Kidney Transplantation

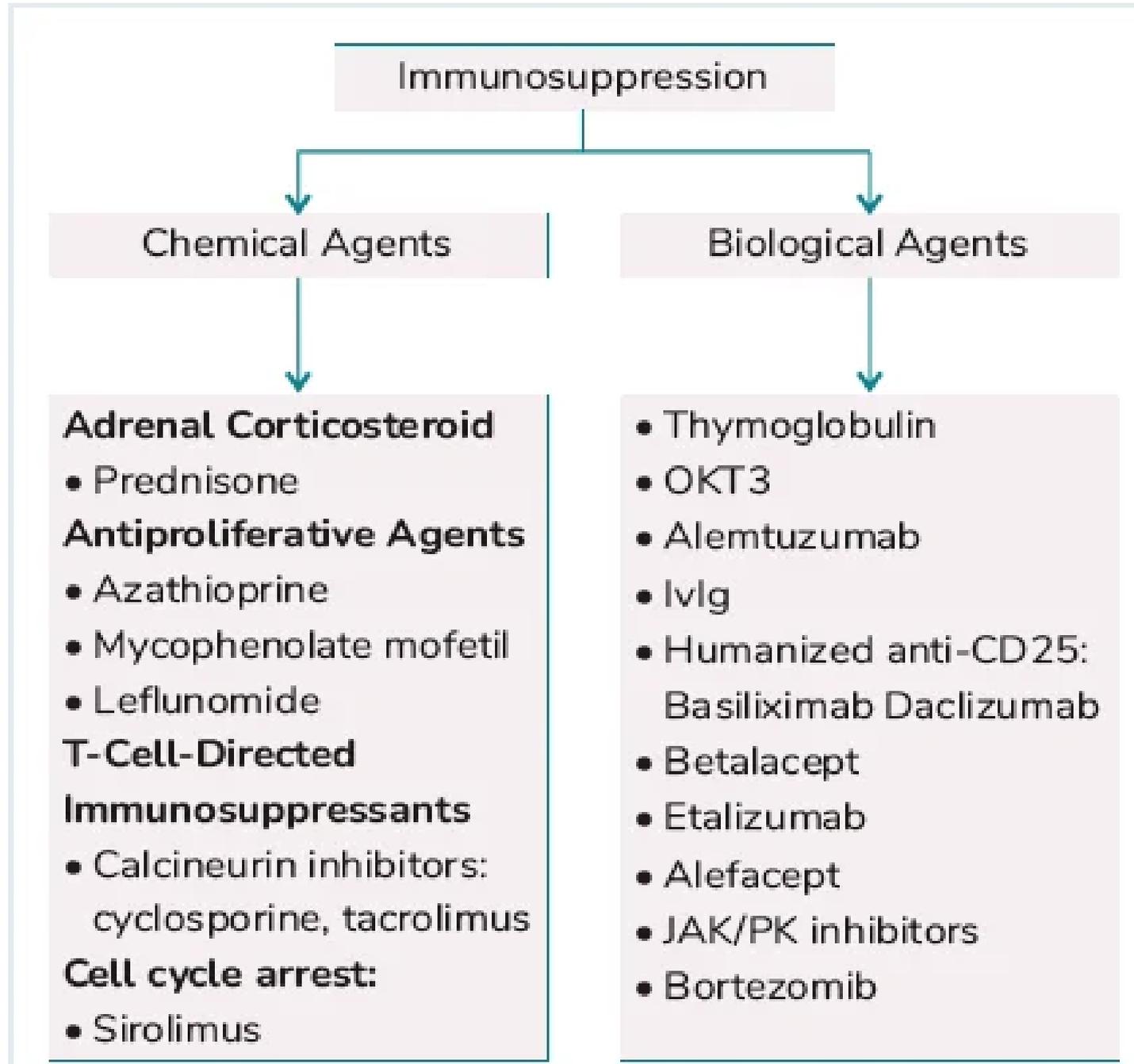
Pre-Transplant:

- 1- HLA typing (matching donor-recipient)
- 2- Crossmatch test (avoid hyperacute rejection)

Post-Transplant:

- 1- Immunosuppressants (Tacrolimus, Mycophenolate, Steroids)
→ suppress T/B cells
 - 2- Monitor for infection & rejection (biopsy, DSA testing)
-  **Technician Role: Monitor for fever, swelling, decreased urine**
→ early rejection signs

Immunosuppression



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graph TD; A[Immunosuppression] --> B[Chemical Agents]; A --> C[Biological Agents]; B --> B1[Adrenal Corticosteroid]; B --> B2[Antiproliferative Agents]; B --> B3[T-Cell-Directed Immunosuppressants]; B --> B4[Cell cycle arrest]; C --> C1[Thymoglobulin]; C --> C2[OKT3]; C --> C3[Alemtuzumab]; C --> C4[IVIg]; C --> C5[Humanized anti-CD25: Basiliximab Daclizumab]; C --> C6[Betalcept]; C --> C7[Etalizumab]; C --> C8[Alefacept]; C --> C9[JAK/PK inhibitors]; C --> C10[Bortezomib];
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Chemical Agents

Adrenal Corticosteroid

- Prednisone

Antiproliferative Agents

- Azathioprine
- Mycophenolate mofetil
- Leflunomide

T-Cell-Directed

Immunosuppressants

- Calcineurin inhibitors:
cyclosporine, tacrolimus

Cell cycle arrest:

- Sirolimus

Biological Agents

- Thymoglobulin

- OKT3

- Alemtuzumab

- IVIg

- Humanized anti-CD25:
Basiliximab Daclizumab

- Betalcept

- Etalizumab

- Alefacept

- JAK/PK inhibitors

- Bortezomib

Pre-transplant immunosuppression

Protocol used:

24 hours before Tx:

- Steroids (prednisone) 5mg/kg (in divided doses)
- MMF 500-1000 mg BD
- Tacrolimus 0.15mg/kg over 2 doses
- 1 hour before Tx: (except close relative) Basiliximab (Simulect) 20mg iv (stat) (To be repeated on day 4 after tx).

Post-transplant immunosuppression

Different Protocols in use:

- CyA + MMF + Pred
- CyA + SIR + Pred
- CyA + EVER + Pred
- TAC + MMF + Pred
- TAC + SIR + Pred
- SIR + MMF + Pred
- Basiliximab or daclizumab/ATG

Vaccination in Dialysis Patients

Recommended Vaccines:

- ▶ Hepatitis B (High-dose or adjuvanted)
- ▶ Influenza (annual)
- ▶ Pneumococcal (PCV13 + PPSV23)
- ▶ COVID-19 + boosters
- ▶ Varicella Zoster (Shingrix)

♣ ♣ Note: Check anti-HBs titers post-HepB vaccine →
revaccinate if <10 mIU/mL

References & Further Reading

1- Abbas, A.K. Basic Immunology, 7th Ed. (2023)

2- KDIGO Guidelines: “Care of Kidney Transplant Recipients” (2024)

3- CDC: “Vaccination for Patients with Chronic Kidney Disease”

4- Nature Reviews Nephrology: “Immune Dysfunction in ESRD” (2023)

5- Fresenius Clinical Handbook – Infection Control Section