Physiology

Immunity and WBCs

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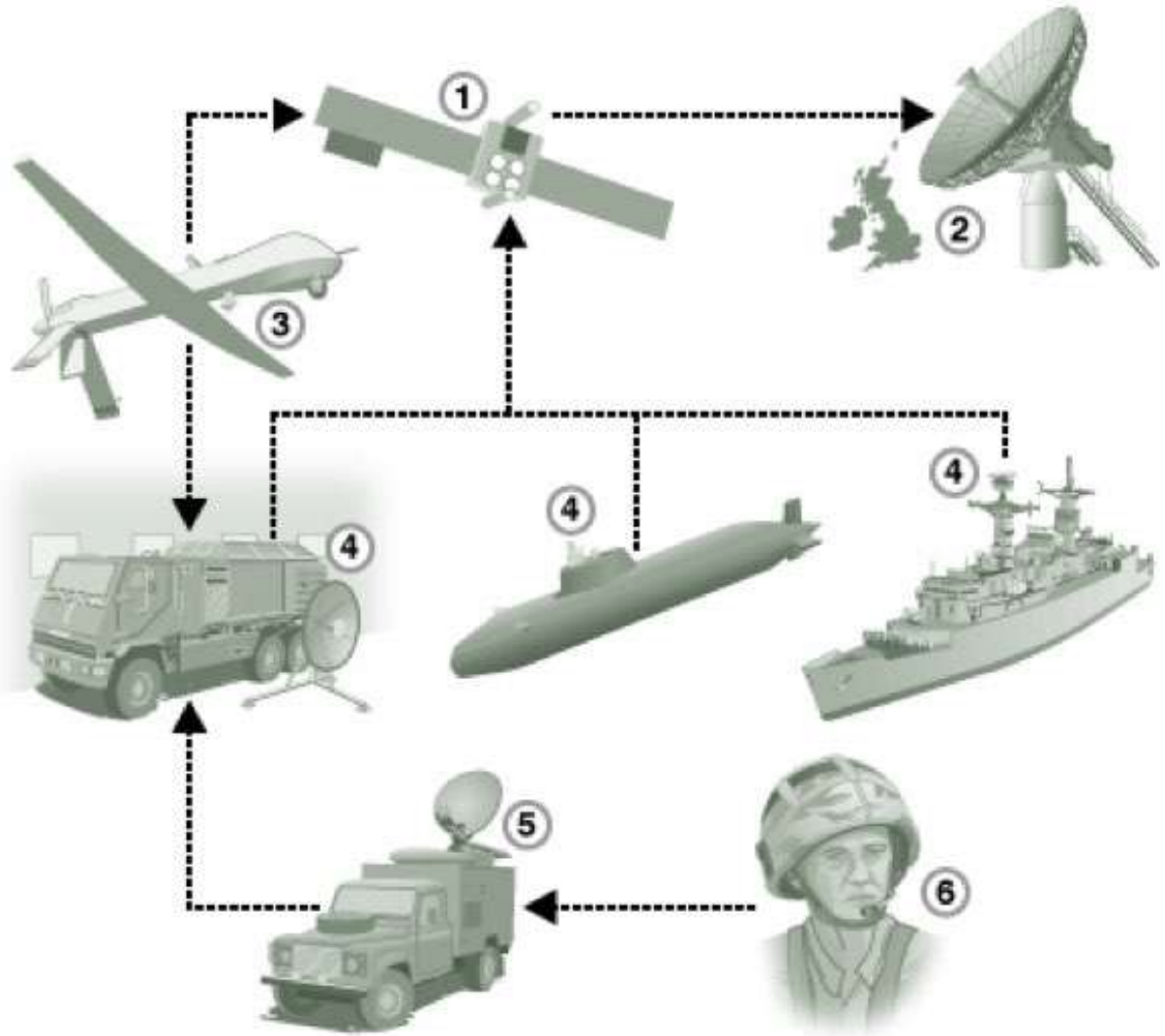
Immunity



Military strategy

Anatomy

Central Immune Organs:

- Thymus
- Bone Marrow

Peripheral Immune Organs

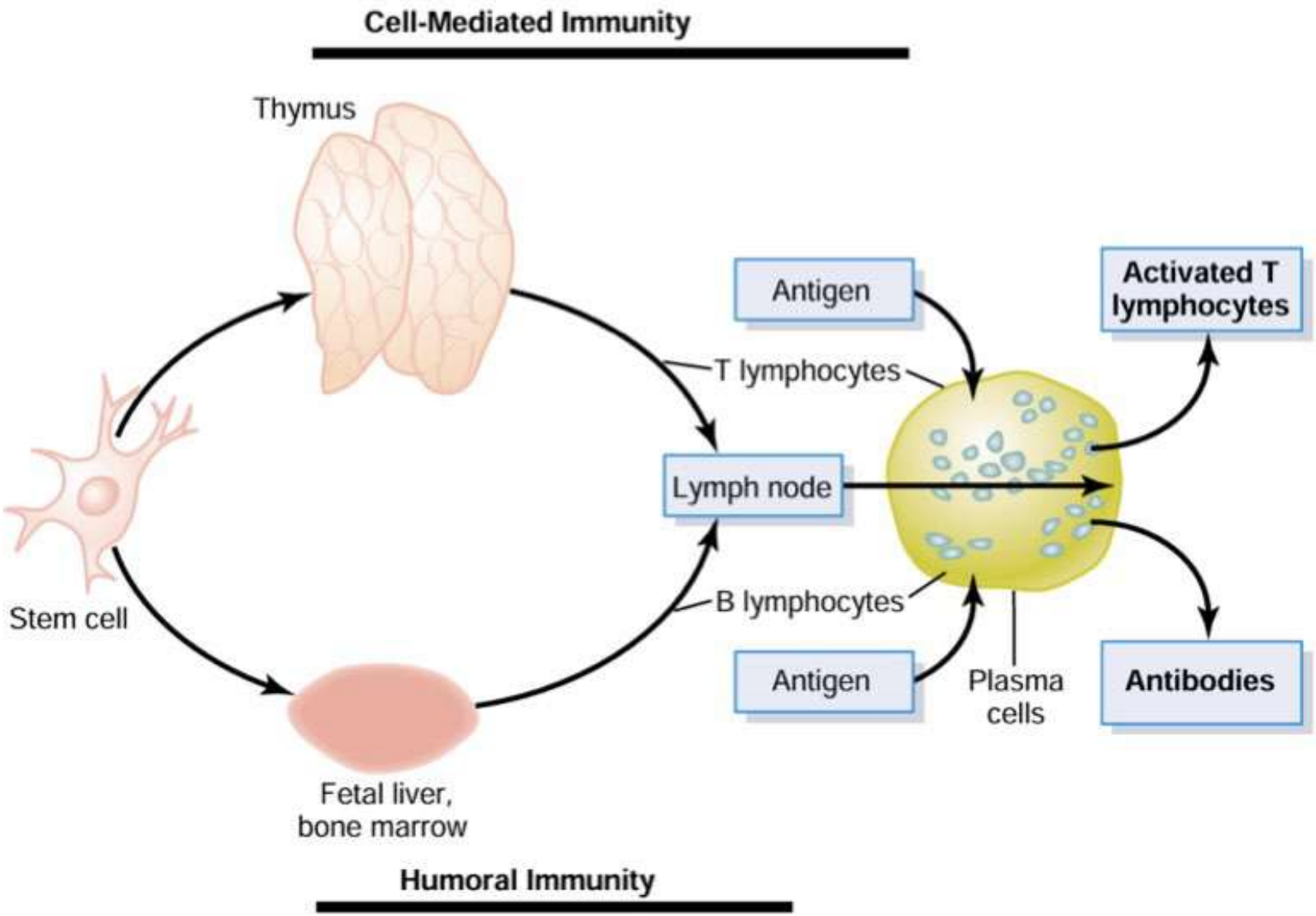
- Lymph Nodes
- Spleen
- MALT (Mucosa associated lymphoid tissue)

Function of the immune system

- Myriads of ***microorganisms*** live on the gigantic surface structures of the human body.
- Because of this, the body must defend itself against its own skin and maintain its identity by means of nonspecific immune mechanisms (***innate***) and specific immune mechanisms (***adaptive***).
- Immunity is based on the body's ability to distinguish between autologous substances ***("self")*** and exogenous substances ***("non-self")***.

Antigen Neutralization

- The body uses several ***strategies*** to render ***antigens harmless***:
- ***Humoral immunity***: This involves the B lymphocytes, which create “antidotes” (antibodies) that circulate in body fluids.
- ***Cell-mediated immunity***: This involves the T lymphocytes that have learned to differentiate between autologous material (“self”) and foreign material (“non-self”).



Formation of antibodies and sensitized lymphocytes by a lymph node in response to antigens. This figure also shows the origin of thymic (T) and bursal (B) lymphocytes that respectively are responsible for the cell-mediated and humoral immune processes.

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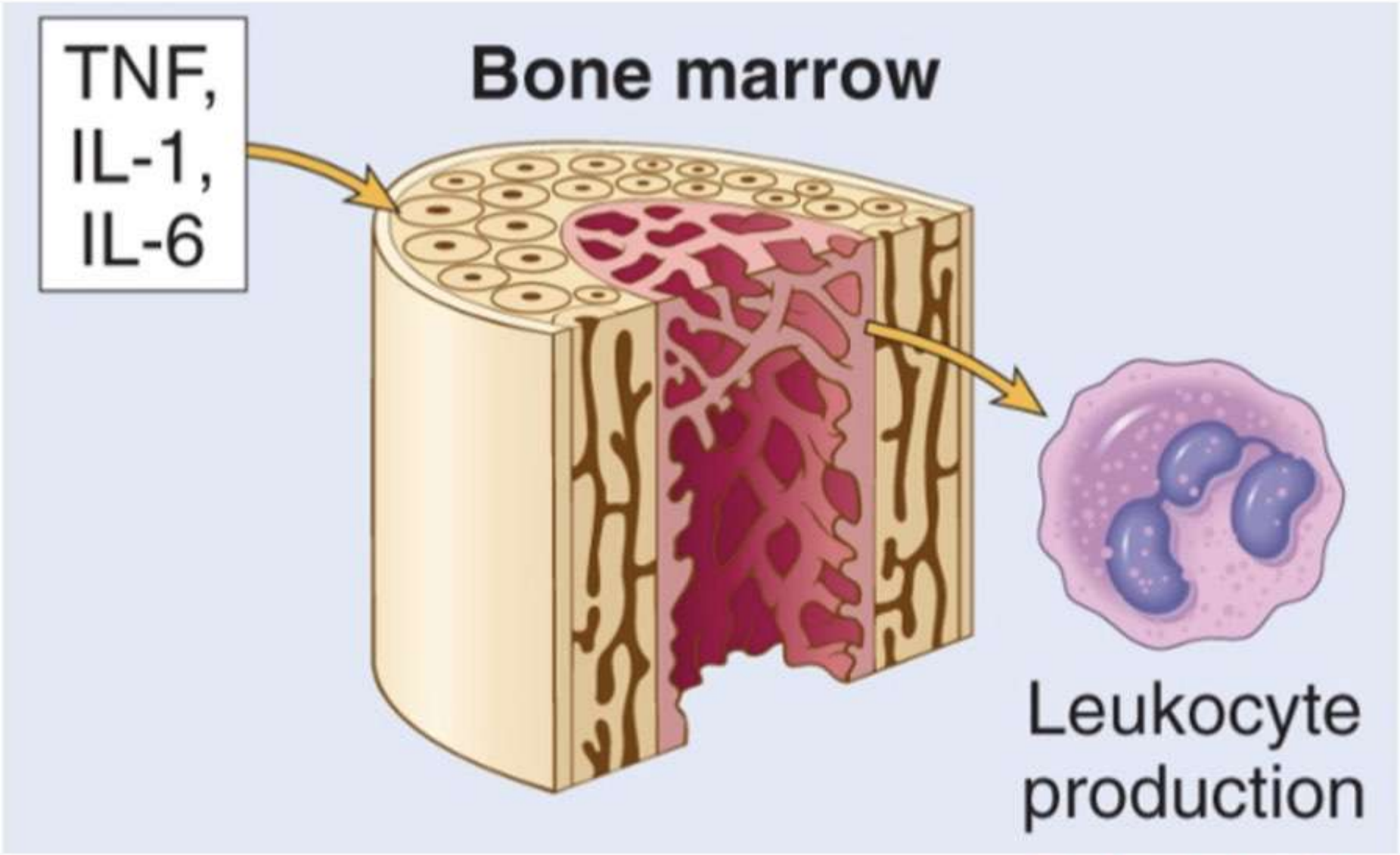
TNF,
IL-1,
IL-6
Bone marrow
Leukocyte
production
Leukocytosis

Leukocyte Formation (Leukopoiesis)

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Leukocytes, or white blood cells (WBCs), are a key component of the immune system and are classified into:

1. Granulocytes (neutrophils, eosinophils, basophils)→mostly responsible for innate (non-specific) immunity.

2. Agranulocytes (monocytes, lymphocytes)→mostly responsible for adaptive (specific) immunity.

Granulocytes:

- **Neutrophils** (60-70%) – Phagocytose bacteria.
- **Eosinophils** (1-3%) – Fight parasites, allergies.
- **Basophils** (<1%) – Release histamine (allergy response).

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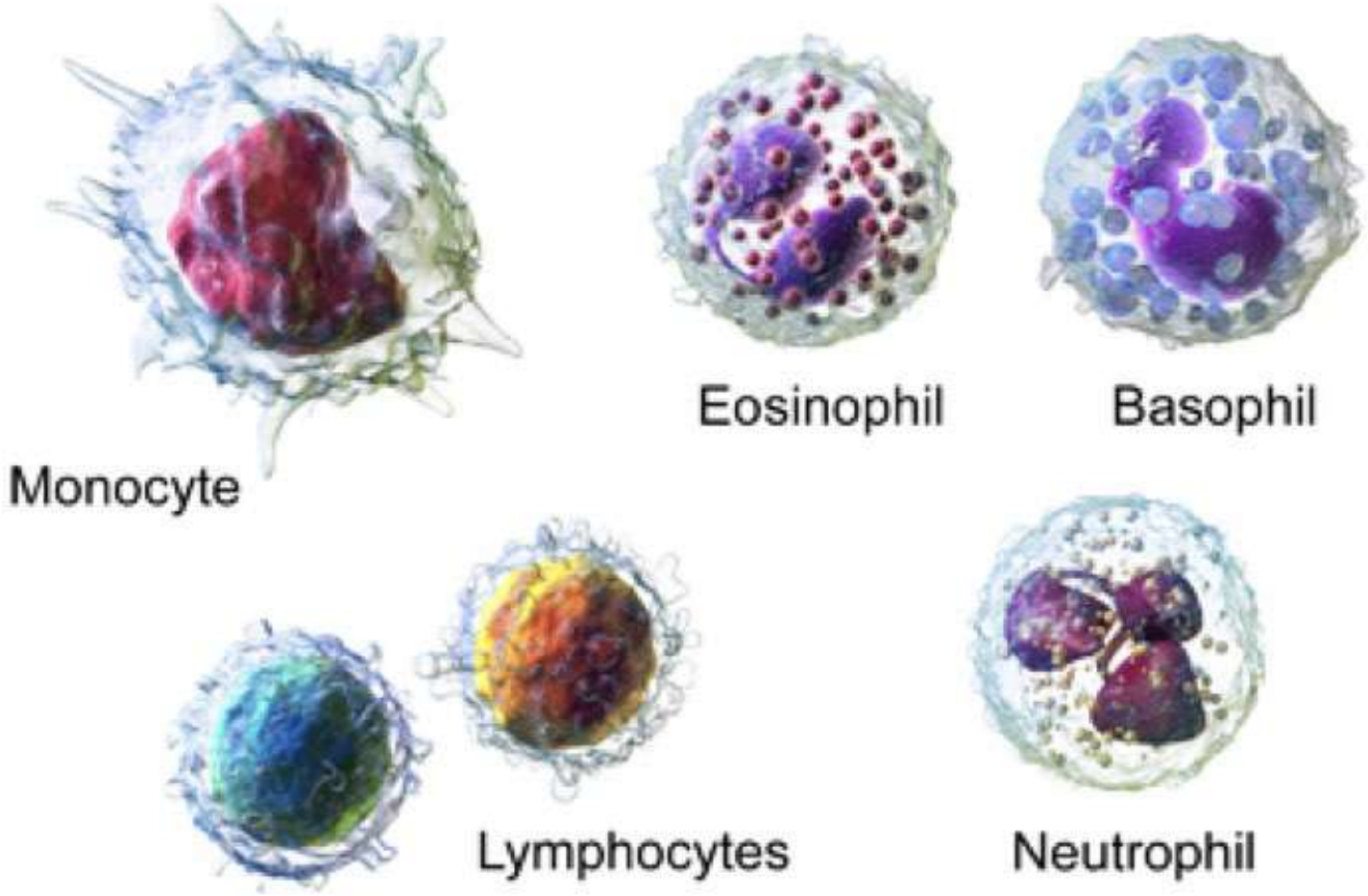

White Blood Cells

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- **Myeloid Lineage** (bone marrow): Makes granulocytes (Granulopoiesis), and monocytes/macrophages.

Granulopoiesis refers specifically to the formation of granulocytes from hematopoietic stem cells (HSCs) in the bone marrow.

- **Lymphoid Lineage**: Makes NK(natural killer) cells and B/T cells (B in marrow, T in thymus).

- Regulated by: **CSF** (colony stimulating factors), interleukins (**IL**).

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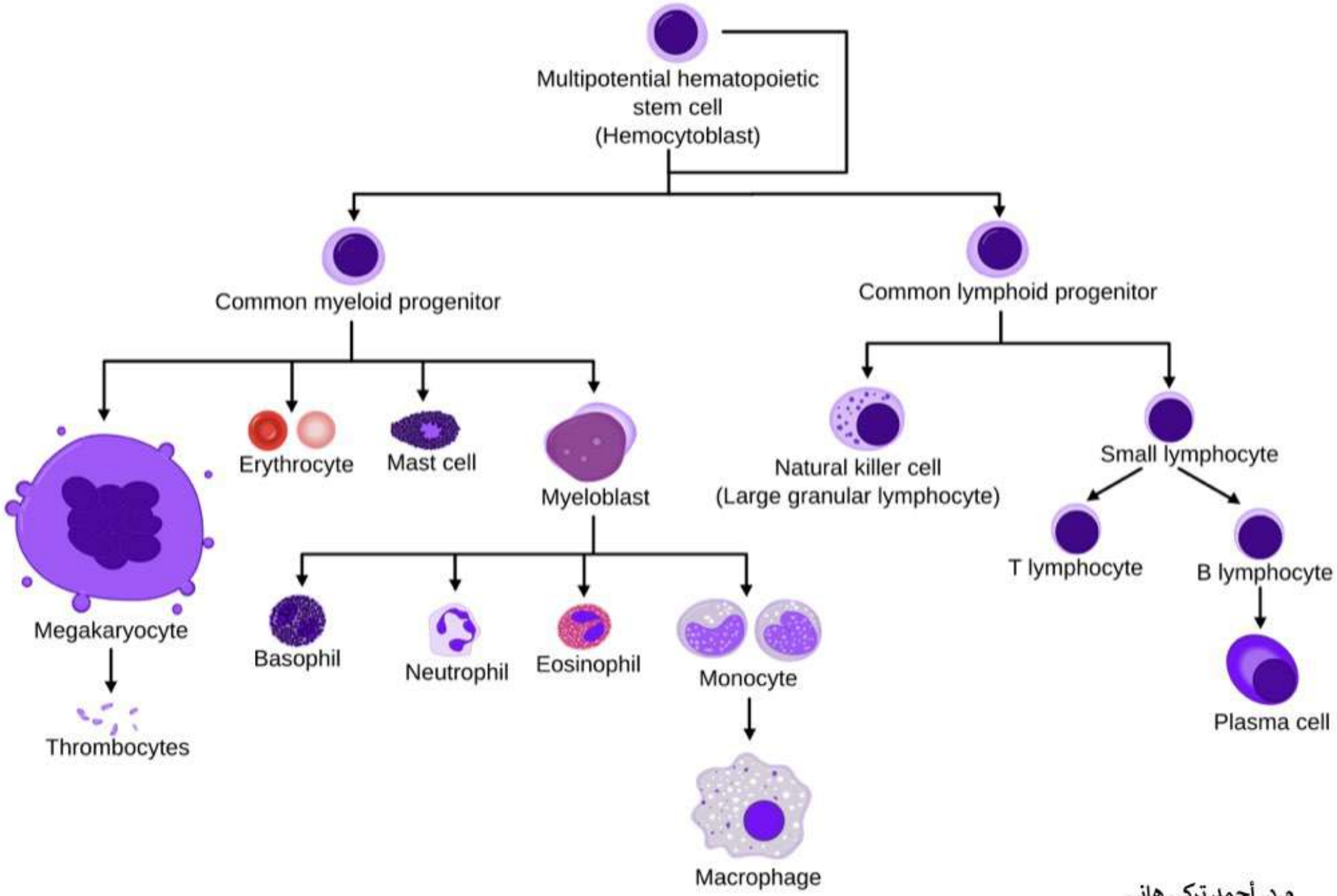

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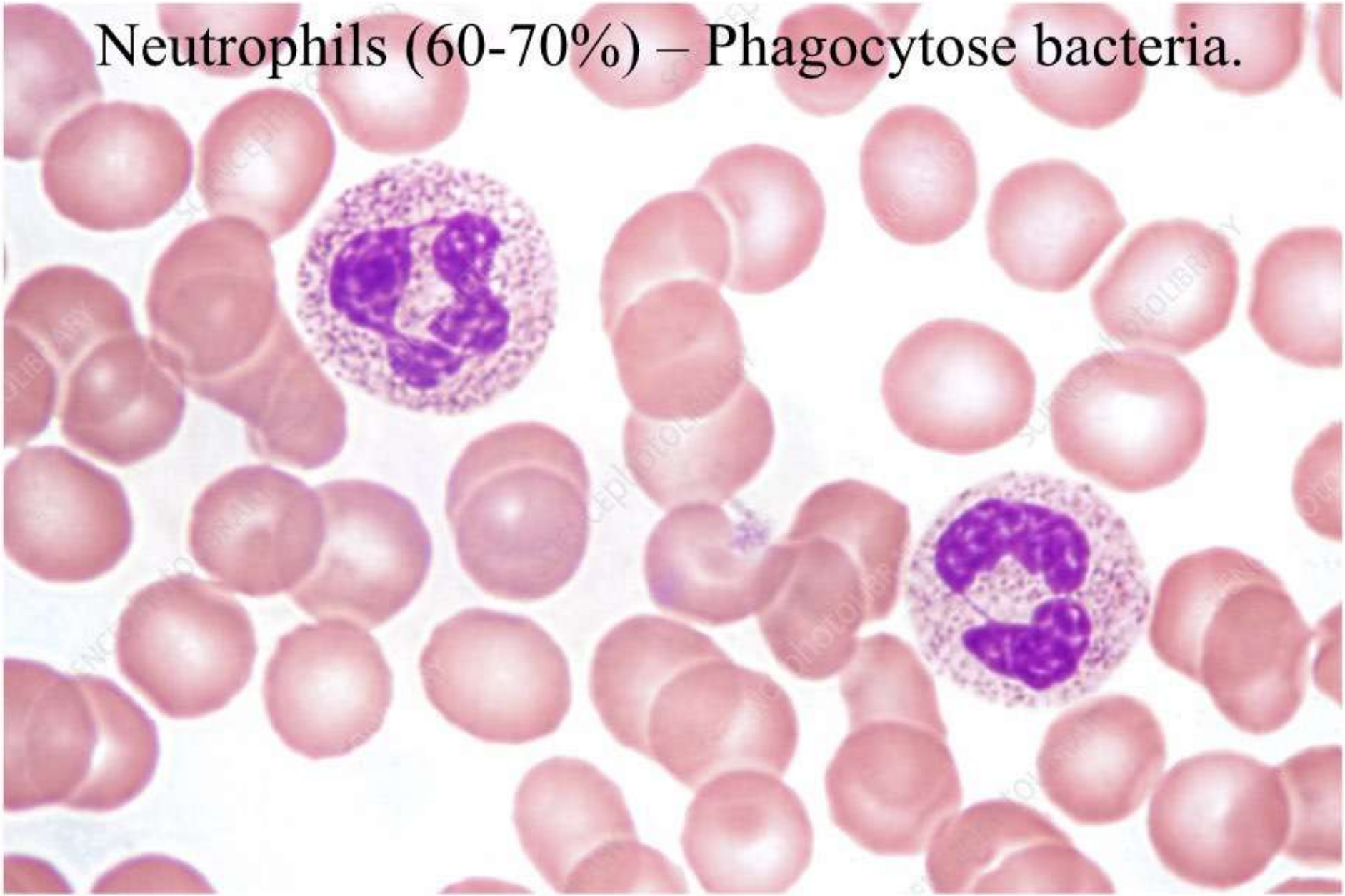
Neutrophils (60-70%) – Phagocytose bacteria.



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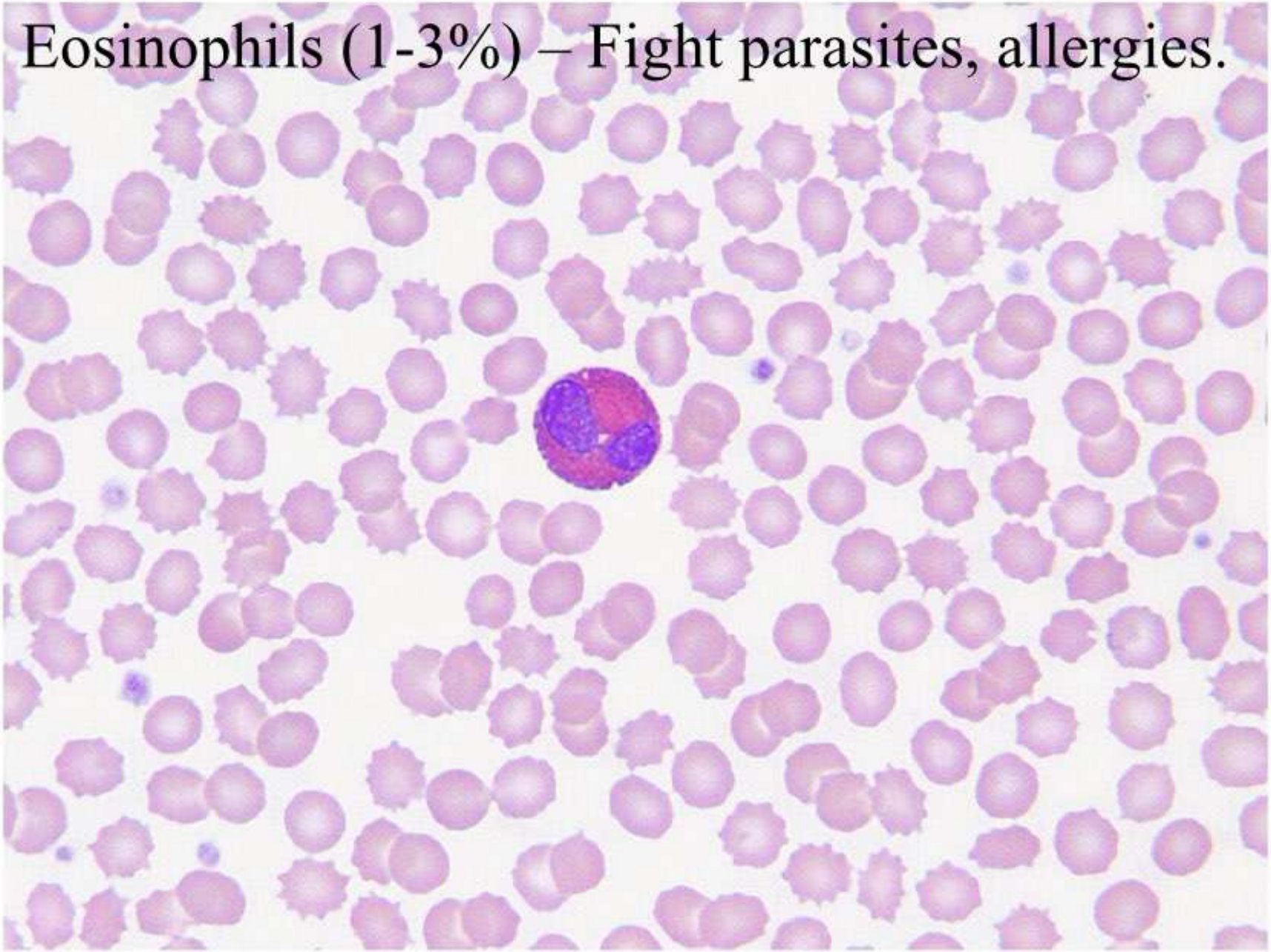
Eosinophils (1-3%) – Fight parasites, allergies.



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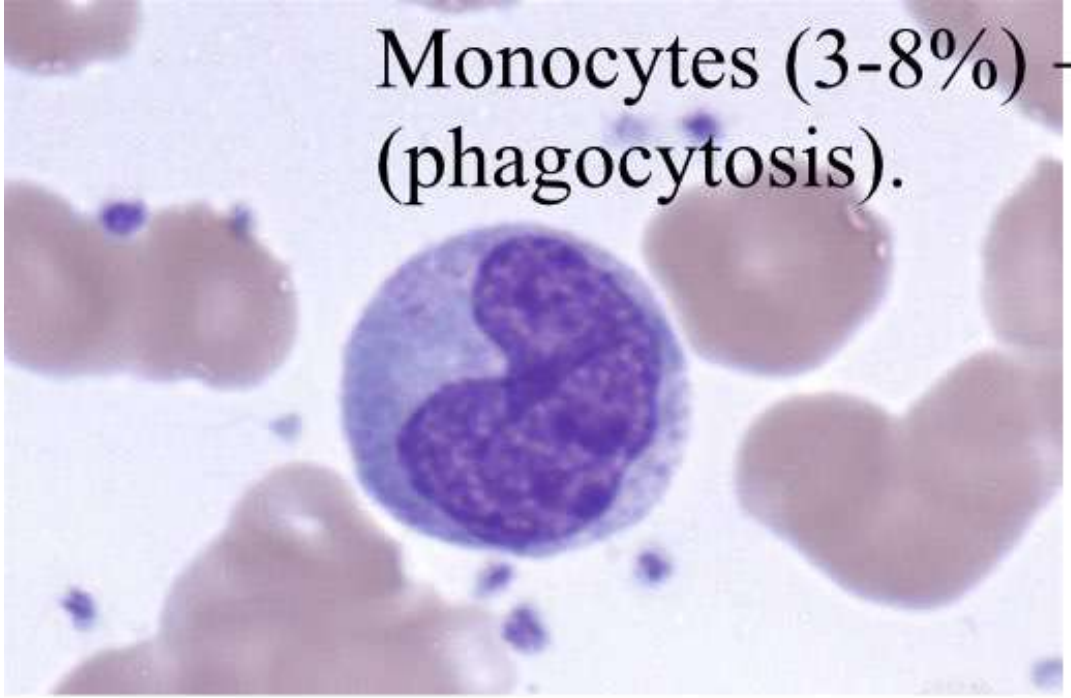
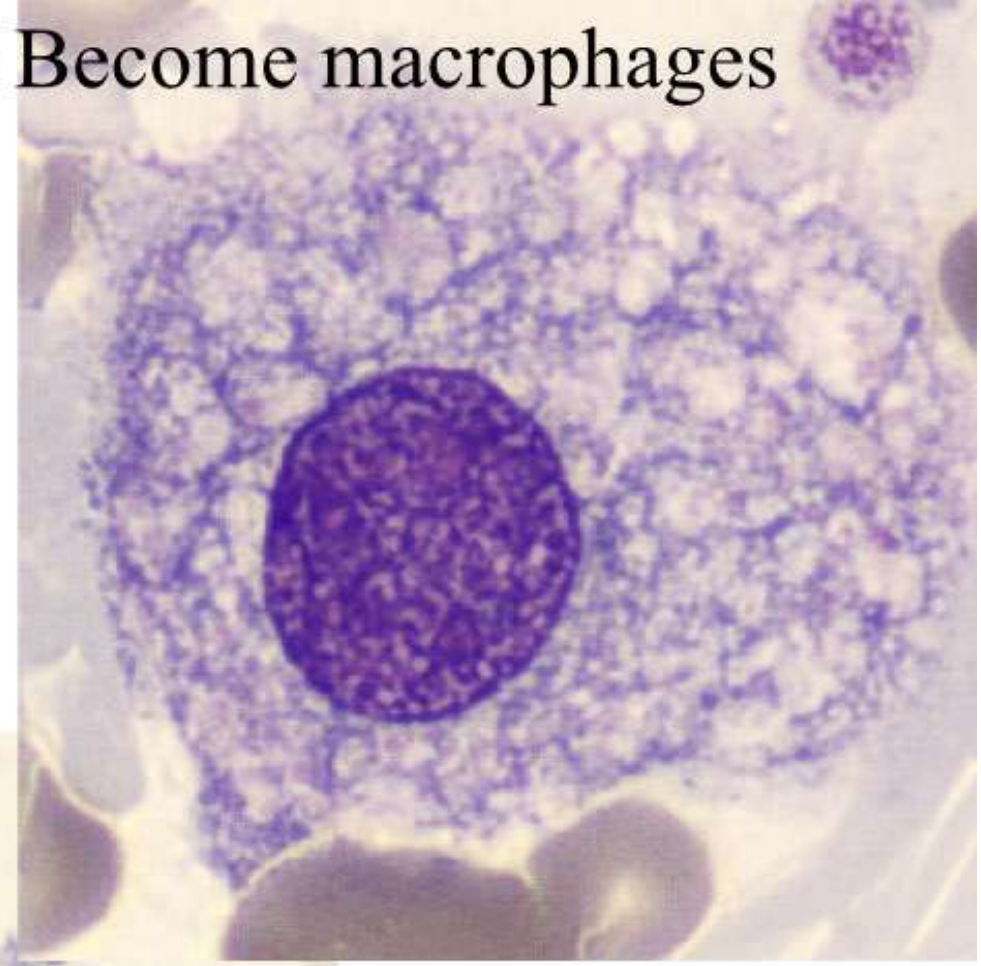
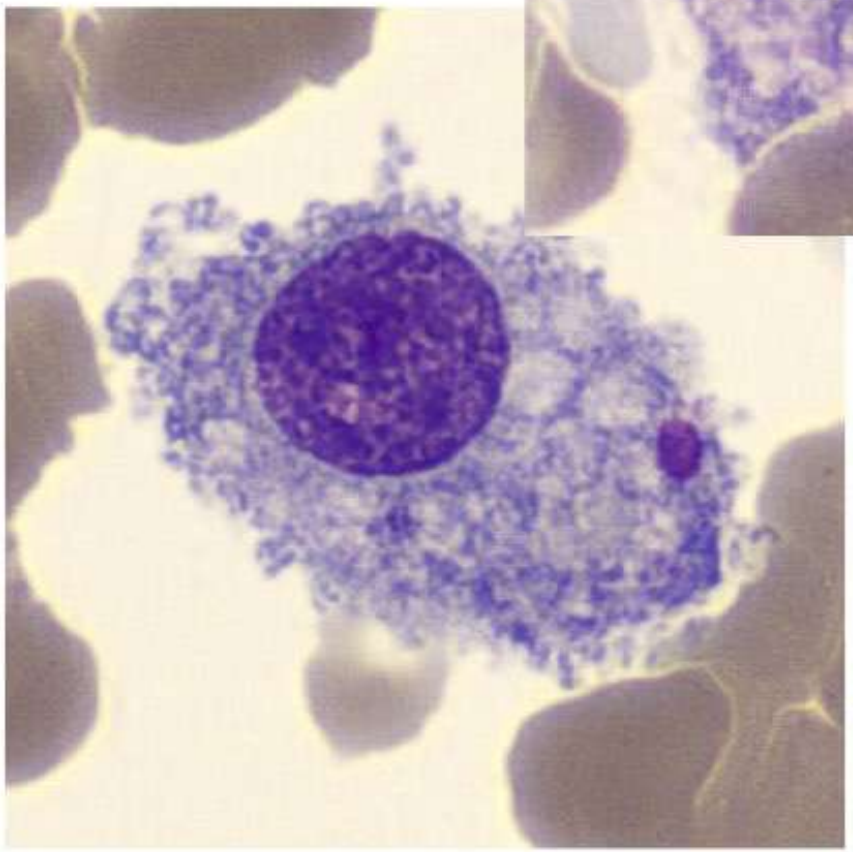
Monocytes (3-8%) → Become macrophages (phagocytosis).







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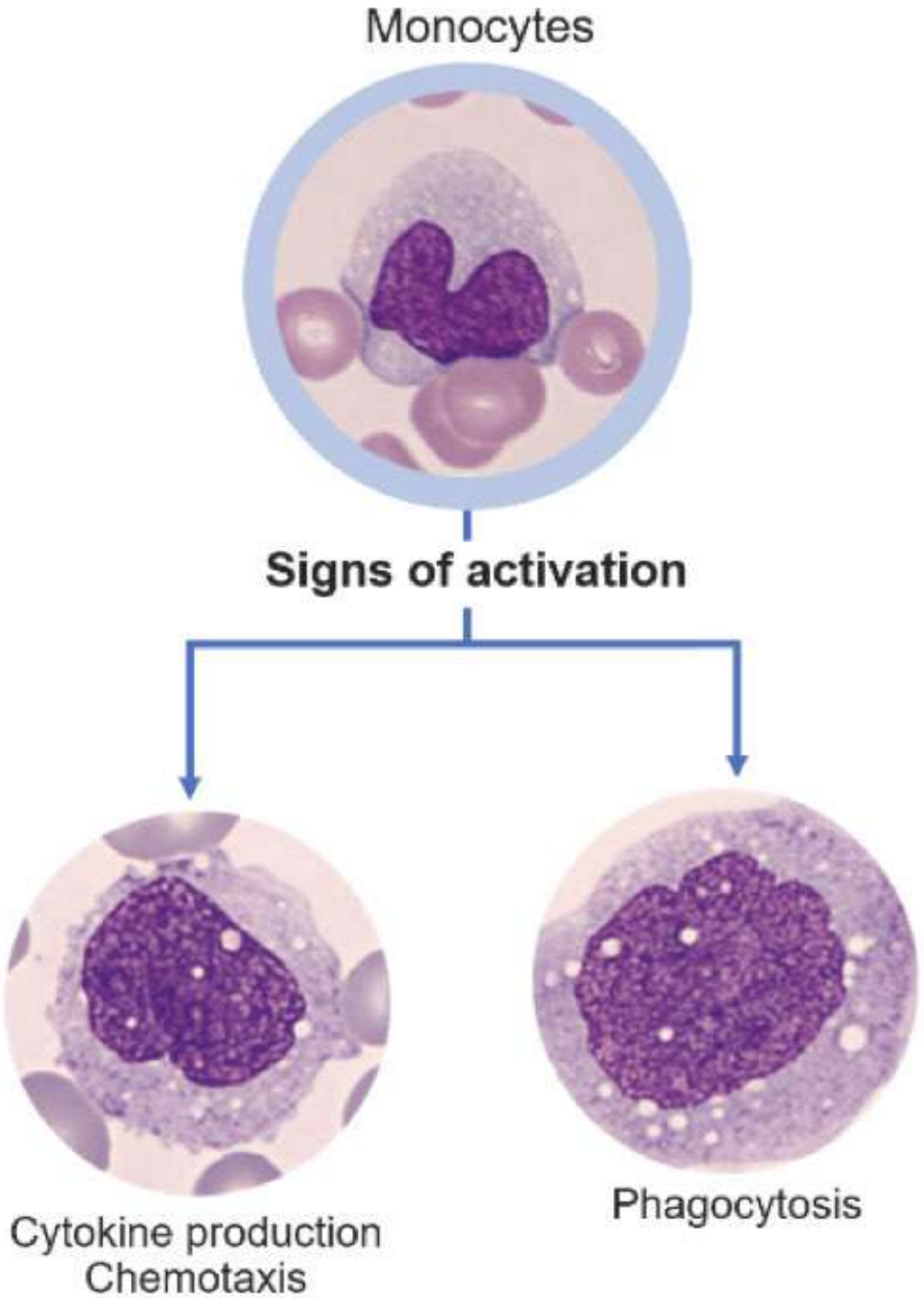

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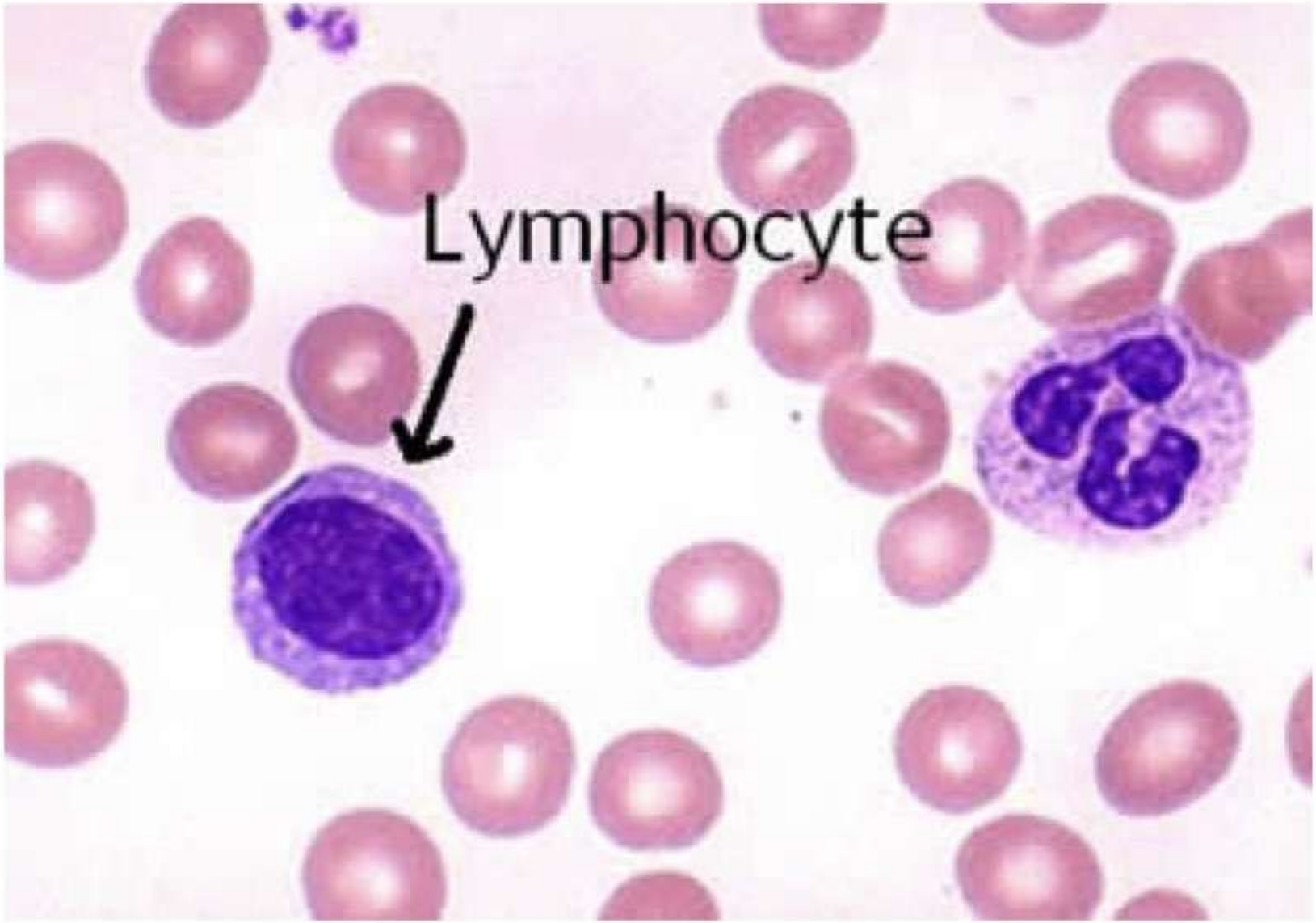
Lymphocytes (20-40%) – B cells-**Plasma cell** (antibodies), T cells-**Cytotoxic cell** (cell-mediated immunity), NK cells (kill infected/cancer cells).



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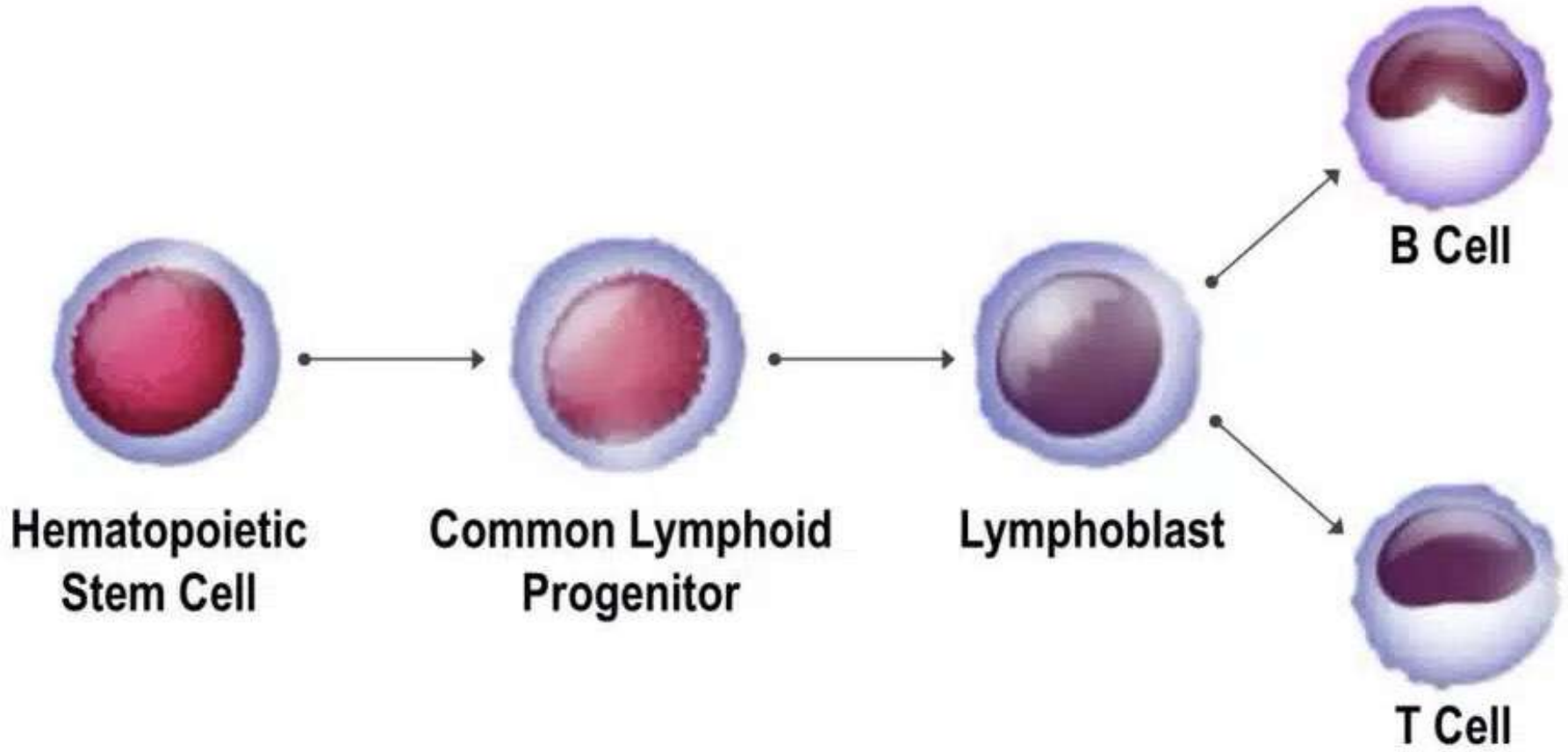

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Clinical Notes

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CBC

	Men (years)	Min–max	Women (years)	Min–max
Haematocrit (%)	16–69	39.2–48.6	16–44	34.4–43.9
			45–54	34.7–44.6
			55–69	35.9–44.6
Haemoglobin (g/L)	16–69	134–167	16–49	115–149
			50–54	118–151
			55–69	121–150
Red blood cells (10^{12}/L)	16–29	4.53–5.79	16–29	4.01–5.19
	30–59	4.38–5.65	30–49	3.93–5.09
	60–69	4.28–5.57	50–69	3.99–5.12
MCV (fL)	16–19	78.0–91.9	16–19	75.7–92.7
	20–39	79.6–94.0	20–29	74.7–94.2
	40–49	81.0–94.9	30–39	77.9–95.3
	50–59	82.2–96.3	40–69	79.9–95.6
	60–69	82.1–97.0		
MCH (pg/cell)	16–19	26.3–32.1	16–29	24.4–32.1
	20–69	27.3–32.8	30–69	26.4–32.6
MCHC (g/L)	16–69	324–363	16–69	319–358
Leucocytes (10^9/L)	16–49	4.09–11.00	16–44	4.02–11.42
	50–59	4.06–10.46	45–49	4.01–11.02
	60–69	4.05–9.92	50–54	3.78–9.70
			55–69	3.78–9.42
Neutrophils (10^9/L)	16–49	1.780–6.946	16–44	1.750–7.500
	50–59	1.915–6.634	45–49	1.812–7.154
	60–69	1.847–6.138	50–54	1.720–6.299
			55–69	1.692–5.839
Eosinophils (10^9/L)	16–19	0.046–0.630	16–19	0.040–0.576
	20–29	0.048–0.593	20–49	0.041–0.549
	30–59	0.046–0.547	50–69	0.044–0.474
	60–69	0.052–0.576		
Basophils (10^9/L)	16–39	0.000–0.097	16–19	0.000–0.081
	40–69	0.000–0.091	20–69	0.000–0.085
Lymphocytes (10^9/L)	16–39	1.340–3.919	16–29	1.370–3.966
	40–69	1.241–3.617	30–69	1.240–3.561
Monocytes (10^9/L)	16–39	0.228–0.773	16–29	0.201–0.714
	40–69	0.233–0.725	30–49	0.205–0.663
			50–69	0.192–0.608
Platelets (10^9/L)	16–59	172–398	16–54	185–445
	60–69	161–393	55–69	187–420
MPV (fL)	16–69	7.4–10.8	16–69	7.5–10.9

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- **Leukopenia**→reduced number of leukocytes→Infection overwhelming (low immunity).
- **Leukocytosis**→increased number of leukocytes→Infection control (good immunity).
- **Severe Leukocytosis**→Leukemia (WBC cancer) →increased number of non functioning leukocytes→Infection overwhelming (low immunity).

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