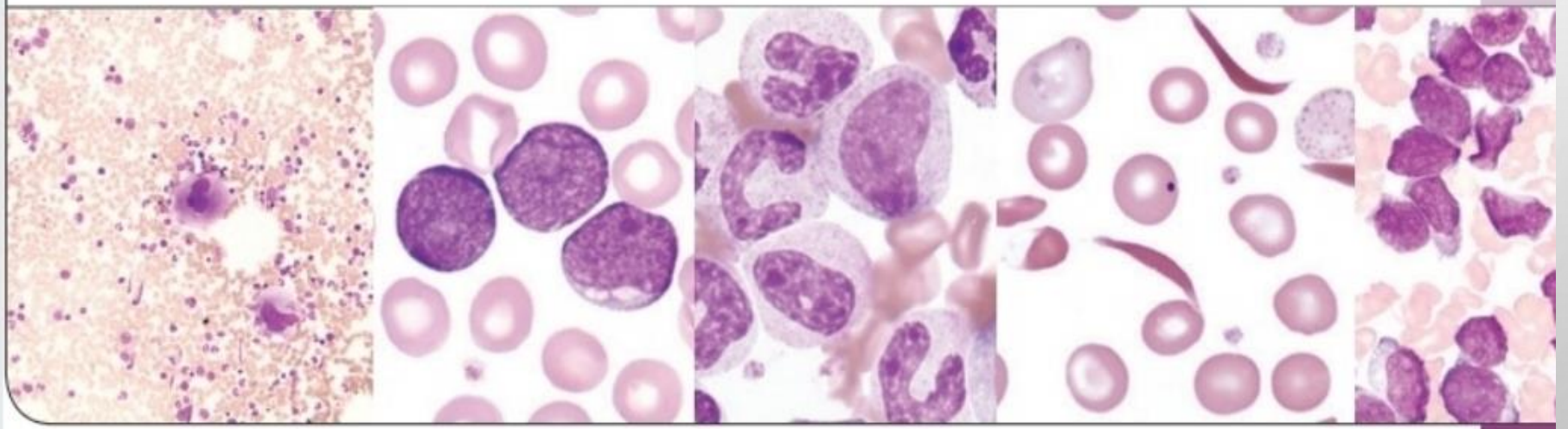
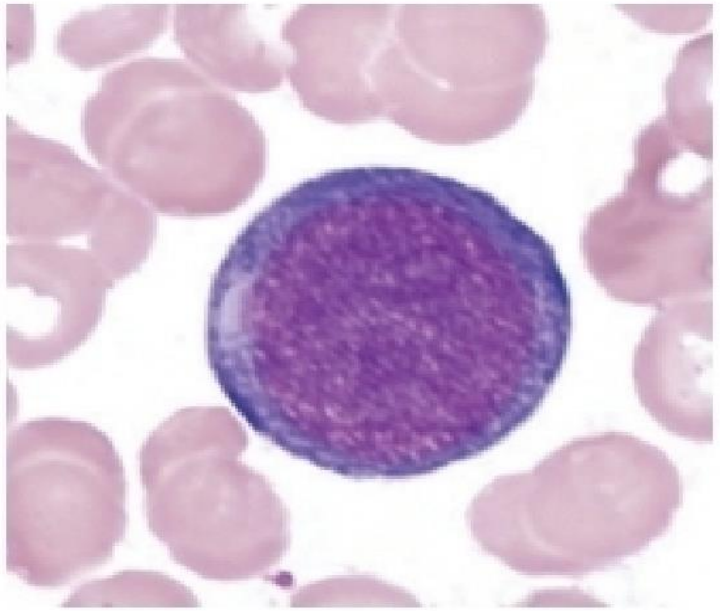
IN THE NAME OF GOD

PERIPHERAL BLOOD SMEAR

DR.A.REZAE

ERYTHROCYTE MATURATION

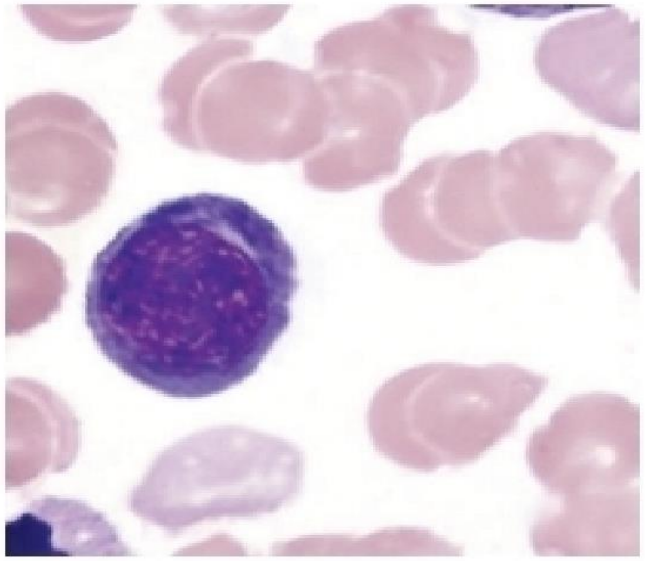




A

FIGURE 3–2A Pronormoblast.

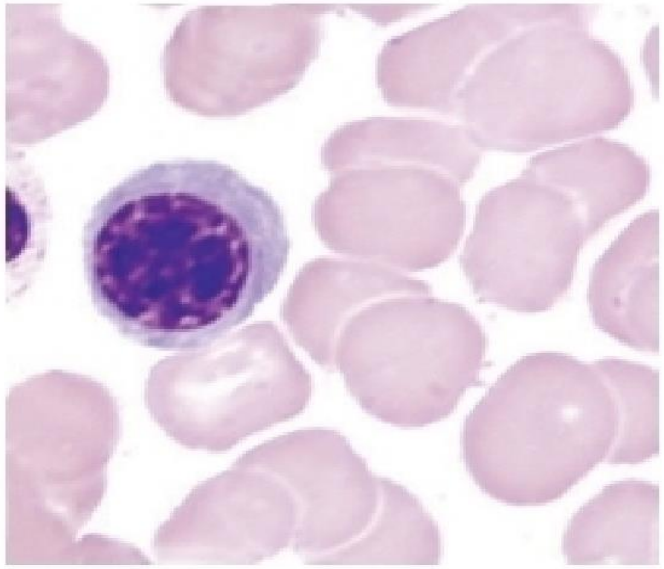
SIZE: 12-20 μm
NUCLEUS: Round to slightly oval
Nucleoli: 1-2
Chromatin: Fine
CYTOPLASM: Dark blue; may have prominent Golgi
N/C RATIO: 8:1
REFERENCE INTERVAL:
Bone Marrow: 1%
Peripheral Blood: 0%



A

FIGURE 3–4A Basophilic normoblast.

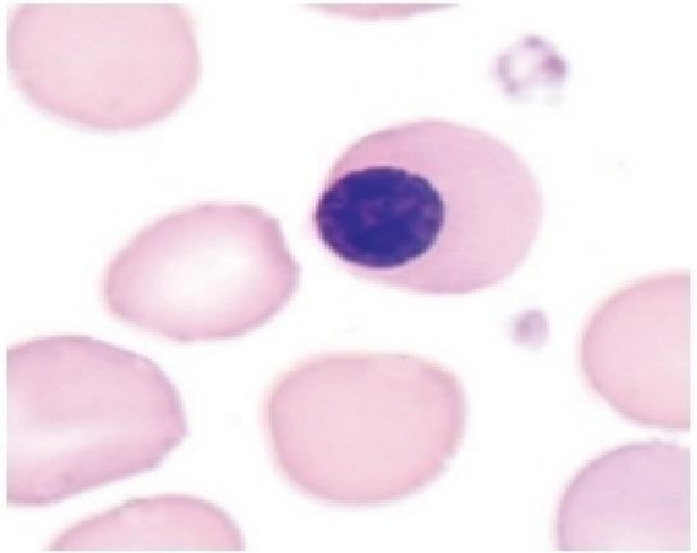
SIZE: 10-15 μm
NUCLEUS: Round to slightly oval
Nucleoli: 0-1
Chromatin: Slightly condensed
CYTOPLASM: Dark blue
N/C RATIO: 6:1
REFERENCE INTERVAL:
Bone Marrow: 1% to 4%
Peripheral Blood: 0%



A

FIGURE 3–6A Polychromatic normoblast. The blue color of the cytoplasm is becoming gray-blue as hemoglobin is produced.

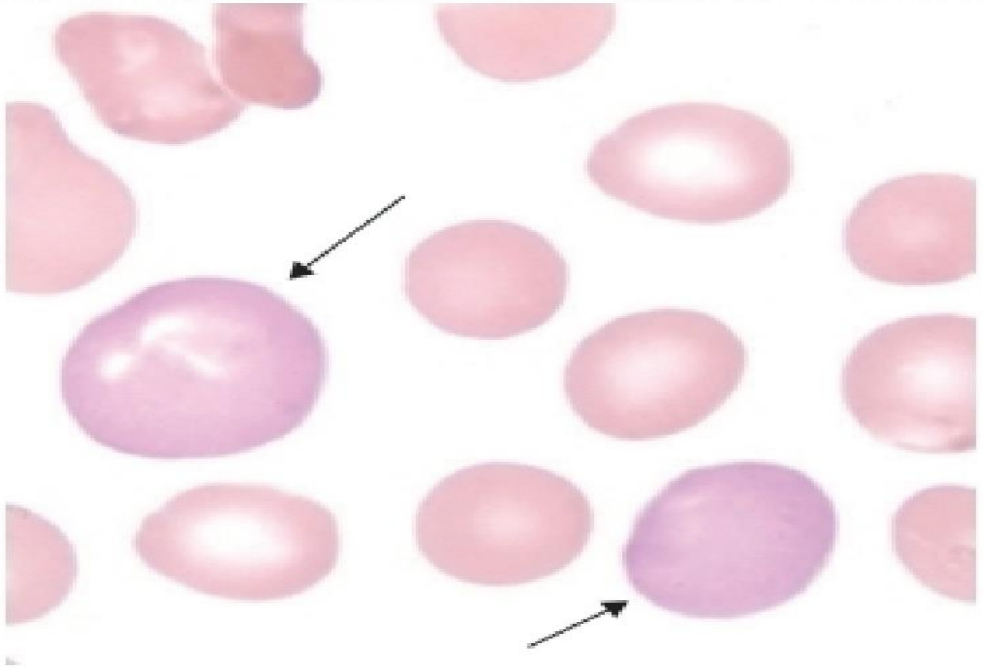
SIZE: 10-12 μm
NUCLEUS: Round
Nucleoli: None
Chromatin: Quite condensed
CYTOPLASM: Gray-blue as a result of hemoglobinization
N/C RATIO: 4:1
REFERENCE INTERVAL:
Bone Marrow: 10% to 20%
Peripheral Blood: 0%



A

FIGURE 3–8A Orthochromic normoblast. The gray-blue color of the cytoplasm is becoming salmon as more hemoglobin is produced.

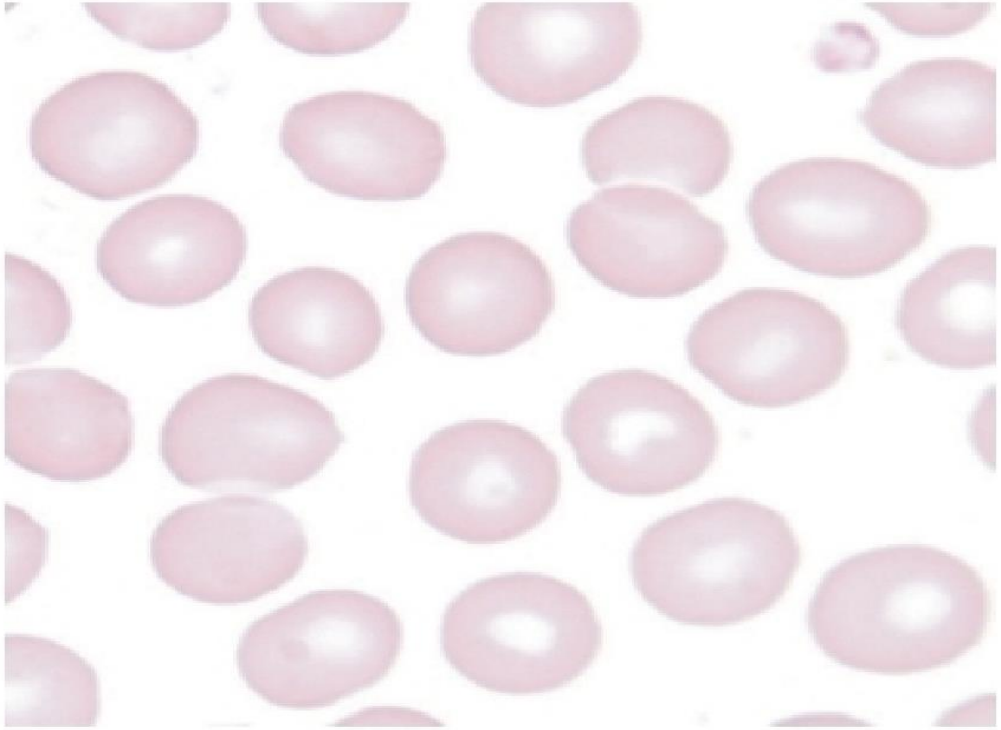
SIZE: 8-10 μm
NUCLEUS: Round
Nucleoli: 0
Chromatin: Fully condensed
CYTOPLASM: More pink or salmon than blue
N/C RATIO: 0.5:1
REFERENCE INTERVAL:
Bone Marrow: 5% to 10%
Peripheral Blood: 0%



A

FIGURE 3–10A Polychromatic erythrocyte. Sometimes appears "lumpy." Slight gray–blue color persists while the cell attains full hemoglobinization.

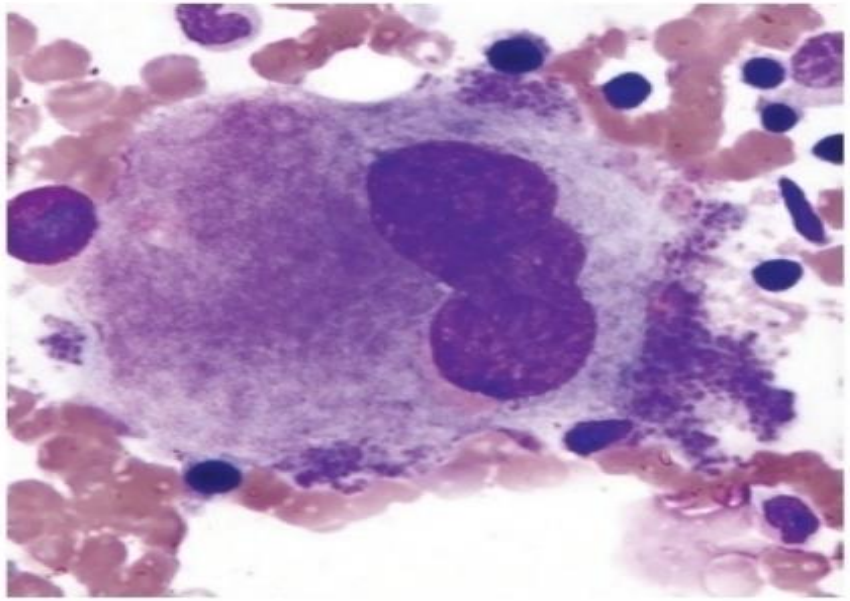
SIZE: 8-8.5 μm
NUCLEUS: Absent
Nucleoli: NA
Chromatin: NA
CYTOPLASM: Color is slightly more blue/purple than the mature erythrocyte
N/C RATIO: NA
REFERENCE INTERVAL:
Bone Marrow: 1%
Peripheral Blood: 0.5% to 2.0%



A

FIGURE 3–12A Erythrocyte. The mature erythrocyte has lost the blue-gray color and is salmon colored as hemoglobinization is complete.

SIZE: 7-8 μm
NUCLEUS: Absent
Nucleoli: NA
Chromatin: NA
CYTOPLASM: Salmon with central pallor of about one-third of the diameter of the cell
N/C RATIO: NA
REFERENCE INTERVAL:
Bone Marrow: NA
Peripheral Blood: Predominant cell type



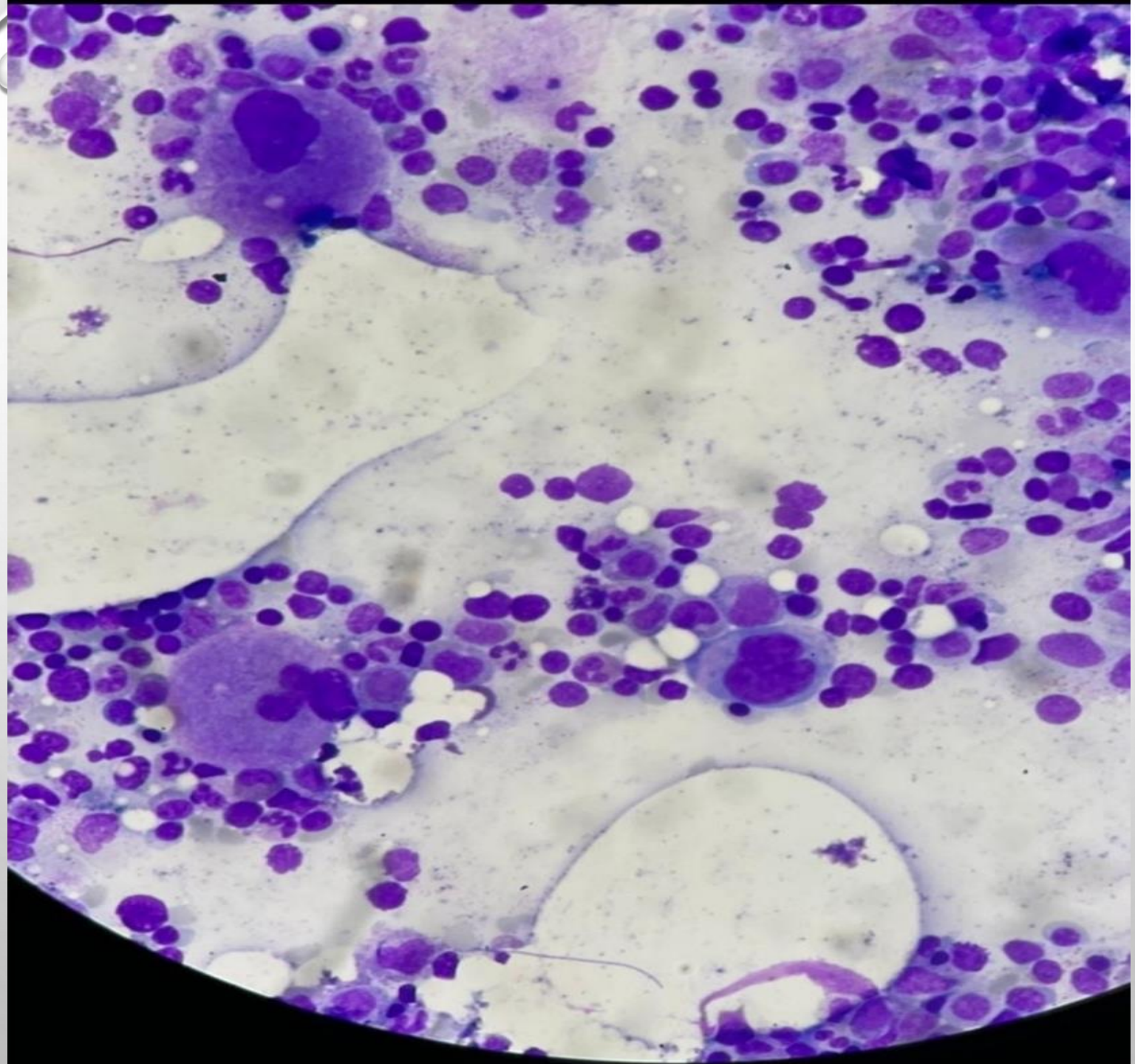
A

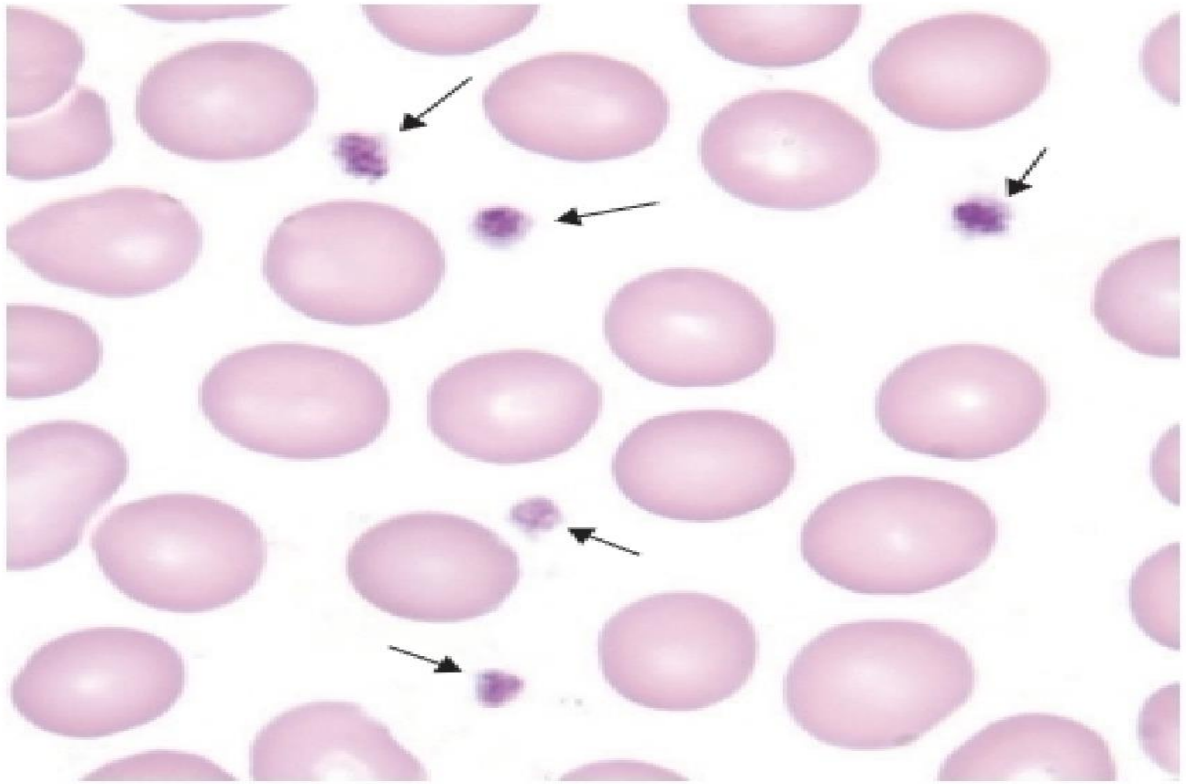
FIGURE 4–6A Megakaryocyte, MK III—bone marrow (×500).

SIZE: 20-90 μm
NUCLEUS: 2-32 lobes (8 lobes: most common)
NOTE: The size of the cell varies according to number of lobes present.
CYTOPLASM: Blue to pink; abundant
Granules: Reddish blue; few to abundant
N/C RATIO: Variable
REFERENCE INTERVAL:
Bone Marrow: 5-10 per 10× objective (×100 magnification)

1–2 per 50× objective (×500 magnification)

NOTE: Megakaryocytes are usually reported as adequate, increased, or decreased and not as a percentage.
Peripheral Blood: 0%



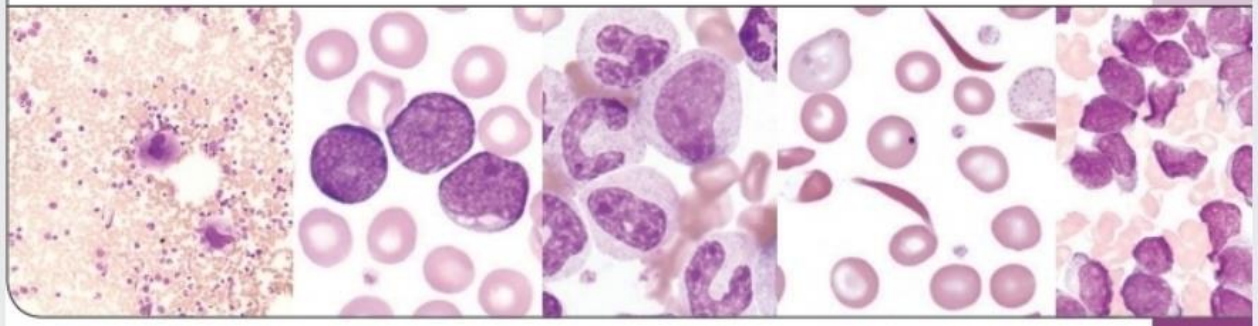


A

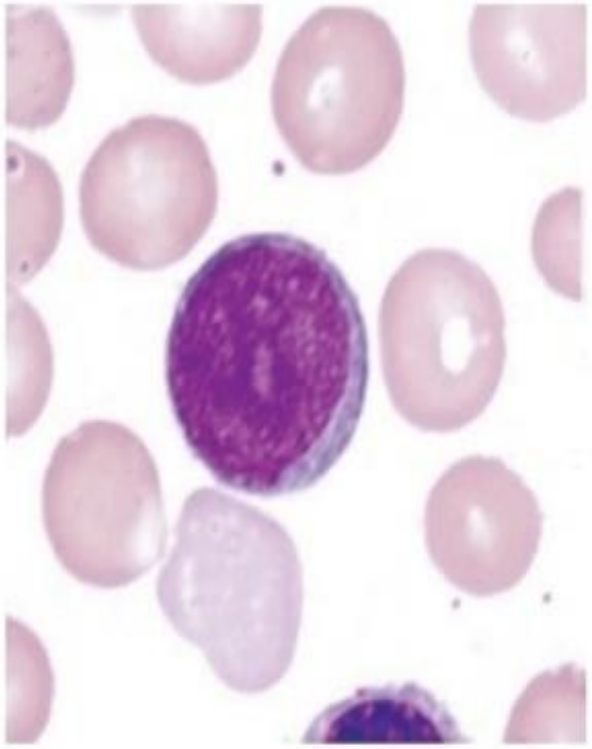
FIGURE 4–8A Platelet—peripheral blood (×1000).

Size: 2-4 μm
Nucleus: NA
CYTOPLASM: Light blue to colorless
Granules: Red to violet, abundant
N/C RATIO: NA
REFERENCE INTERVAL:
Bone Marrow: NA
Peripheral Blood: 7-25 per 100× oil immersion field (×1000 magnification)

NEUTROPHIL MATURATION

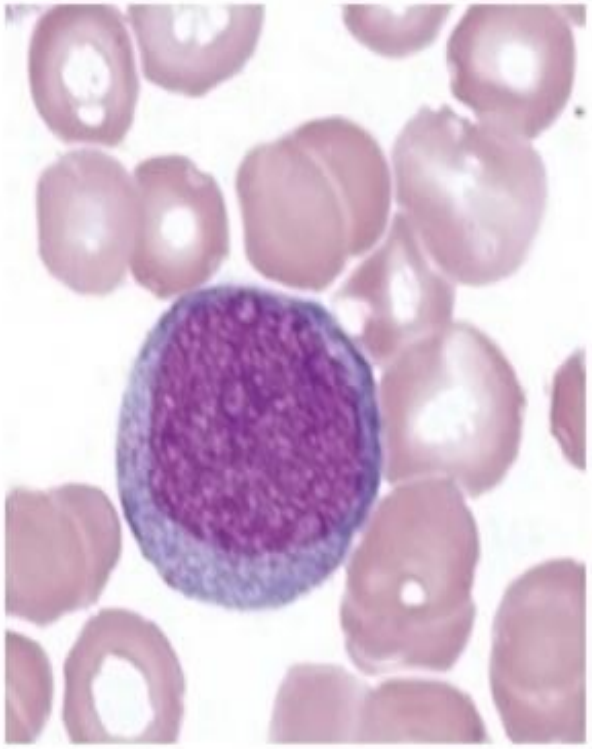


MYELOBLAST



A

FIGURE 5-2A Myeloblast with no granules.



B

FIGURE 5-2B Myeloblast with up to 20 granules.

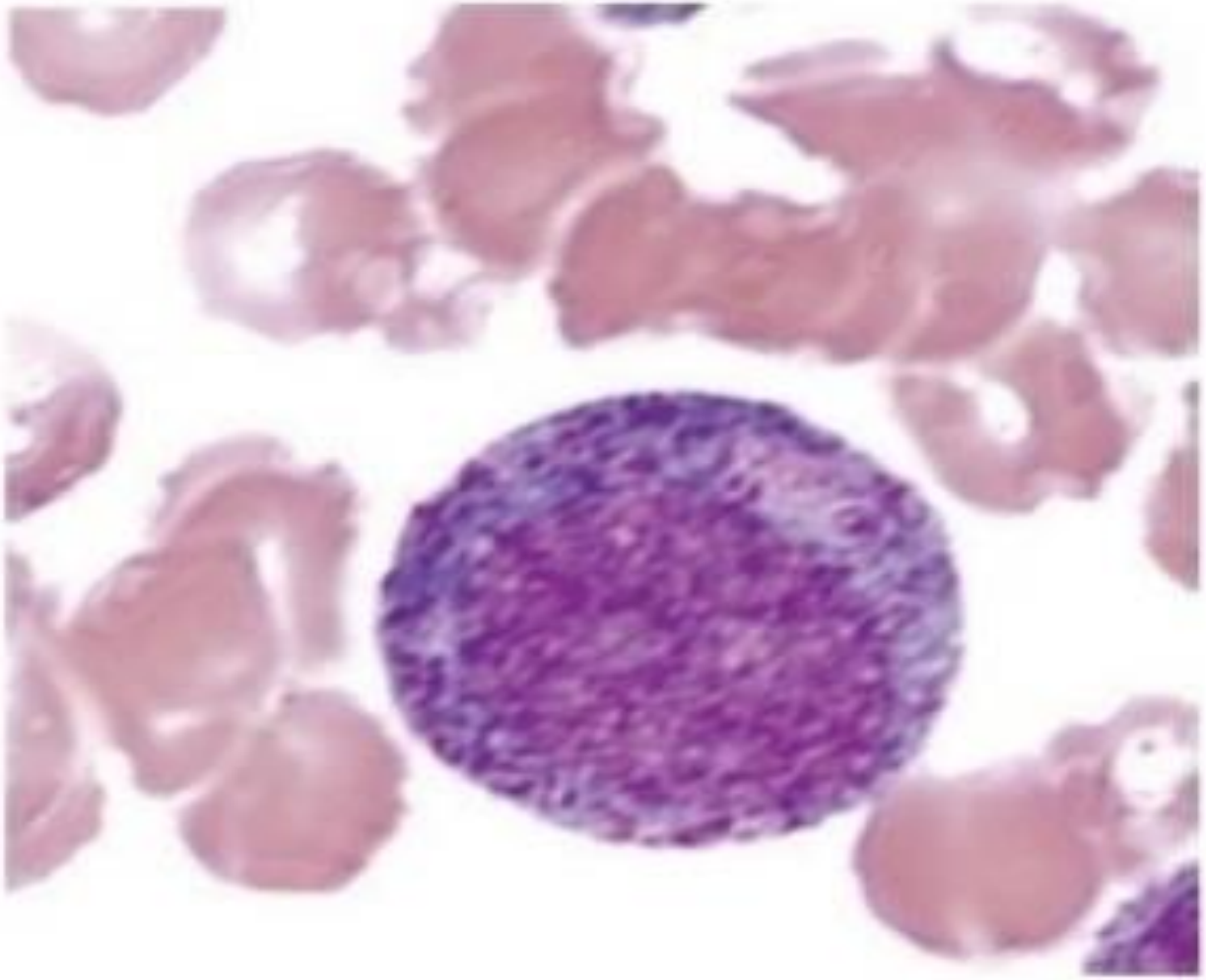


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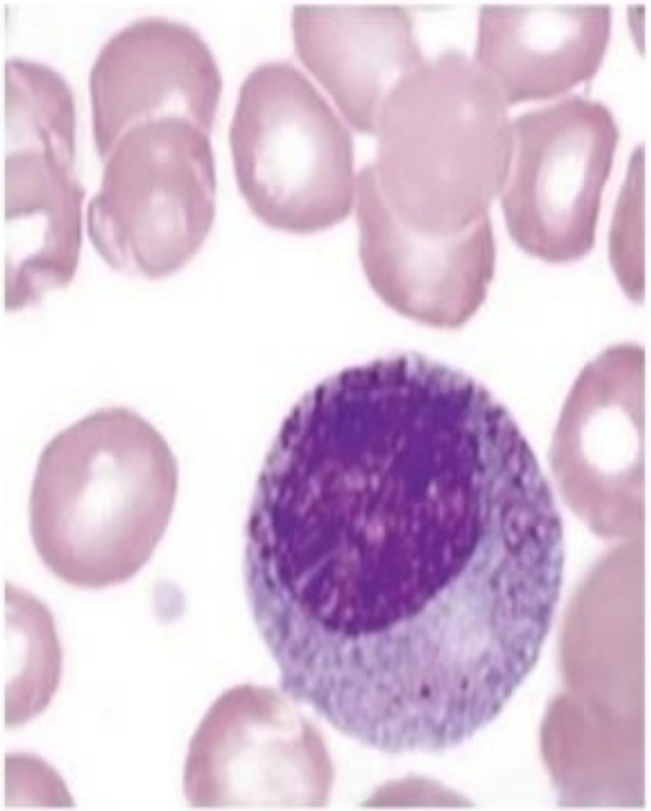
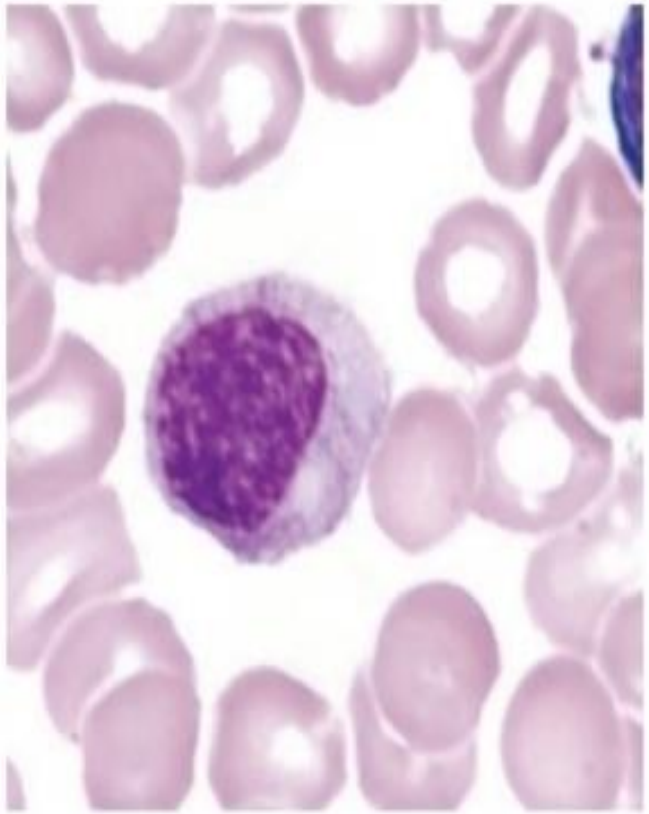
FIGURE 5–4A Promyelocyte.

NEUTROPHILIC MYELOCYTE



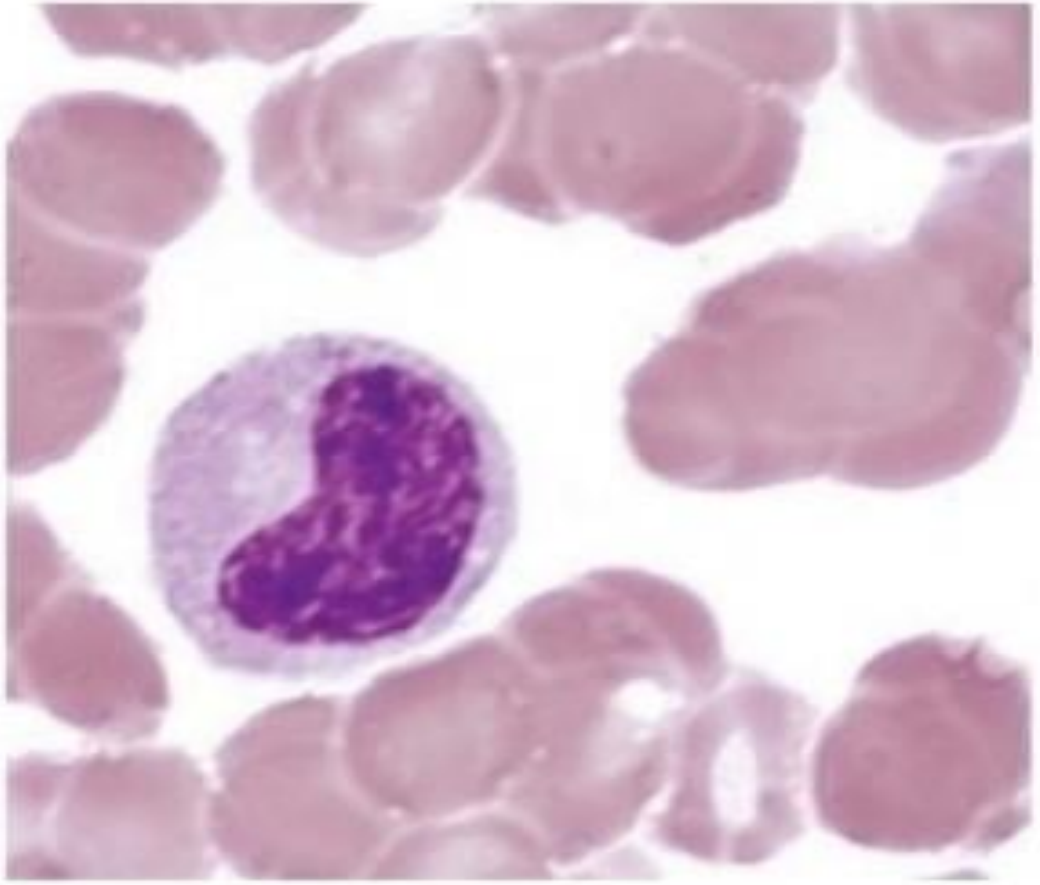
A

FIGURE 5-6A Neutrophilic myelocyte, early.



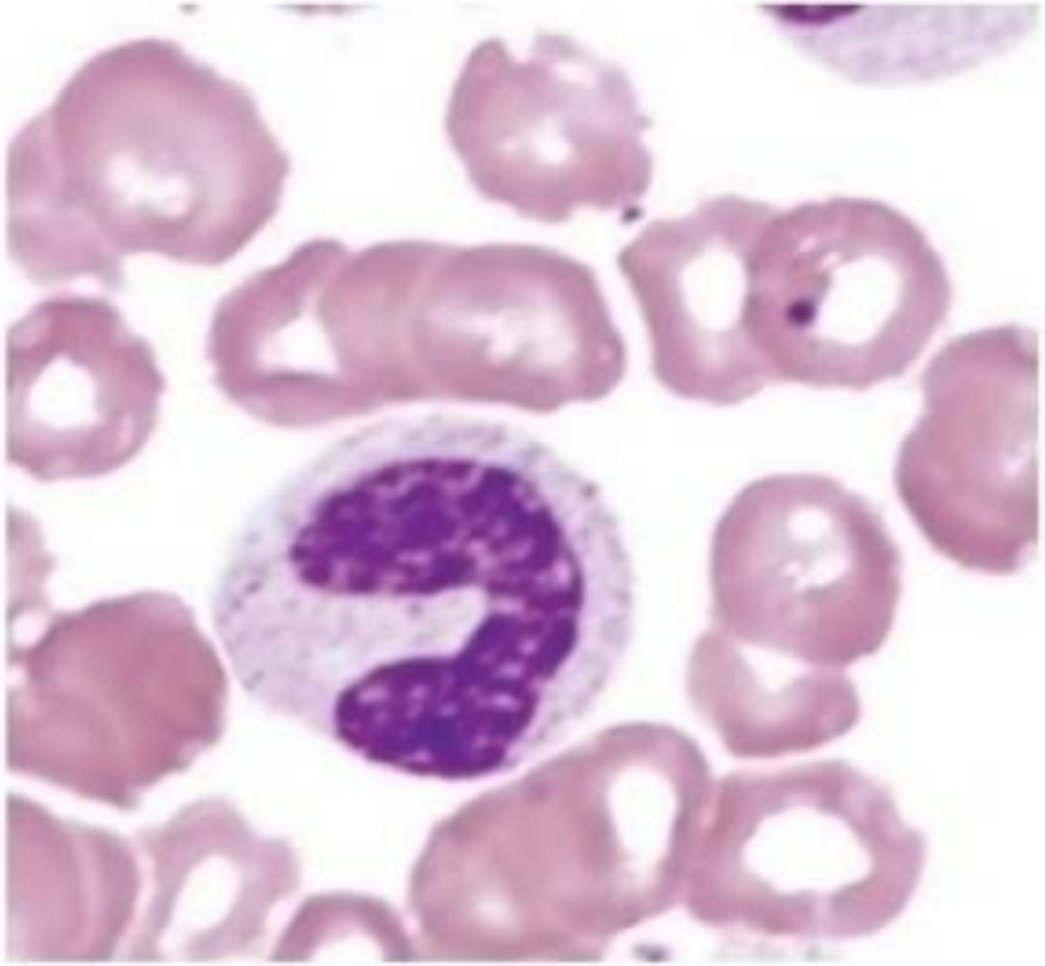
B

FIGURE 5-6B Neutrophilic myelocyte, late.



A

FIGURE 5–8A Neutrophilic metamyelocyte.



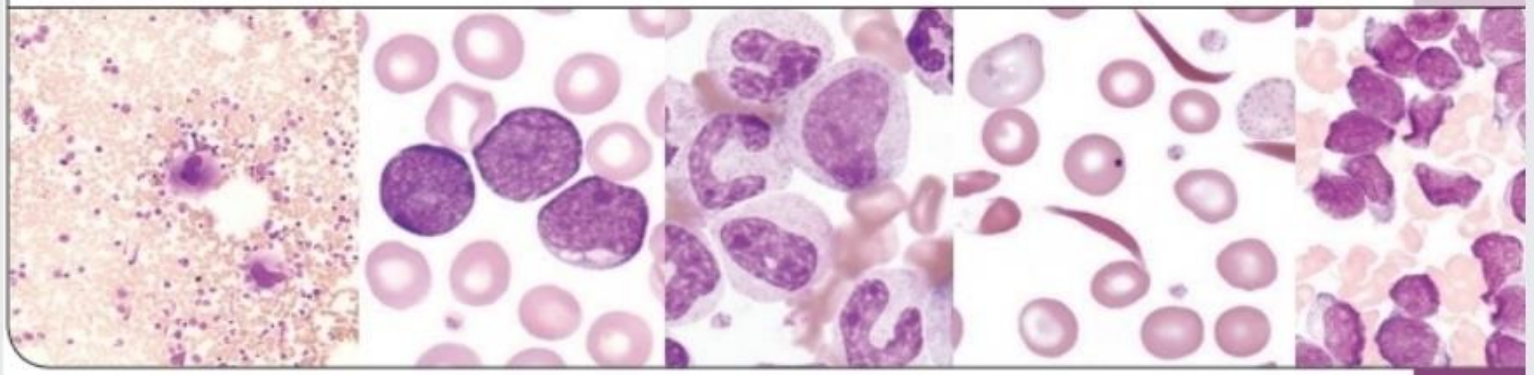
A

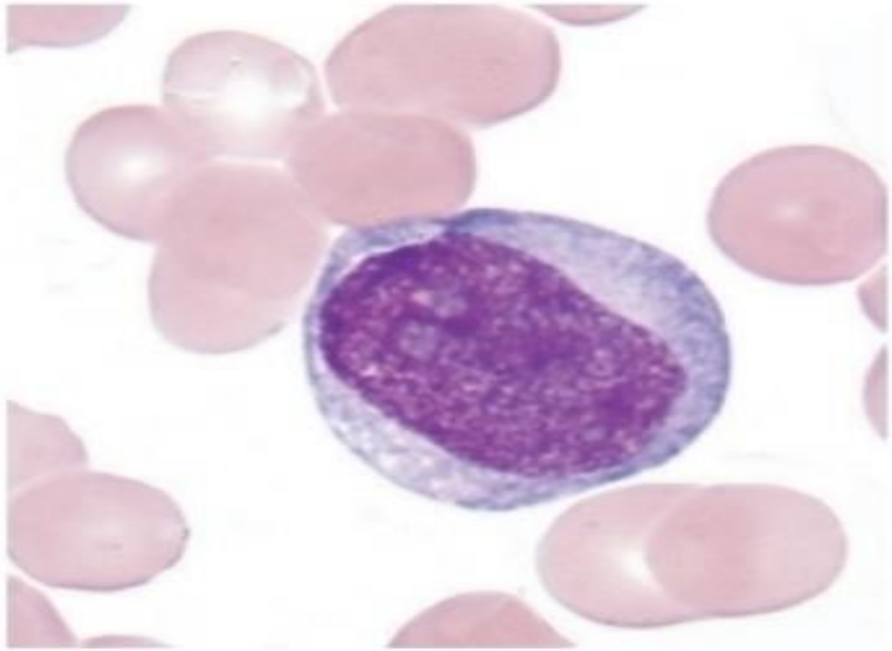
FIGURE 5-10A Neutrophilic band.

A

FIGURE 5-12A Segmented neutrophil.

MONOCYTE MATURATION

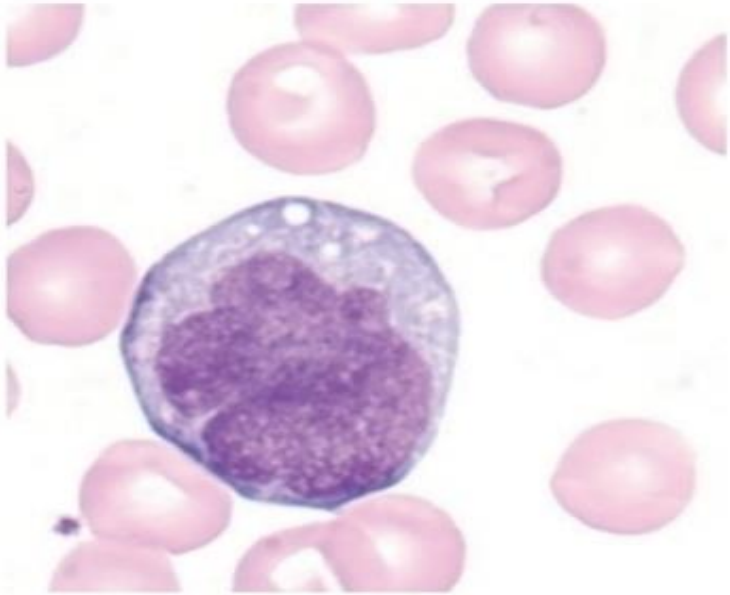




A

FIGURE 6–2A Monoblast.

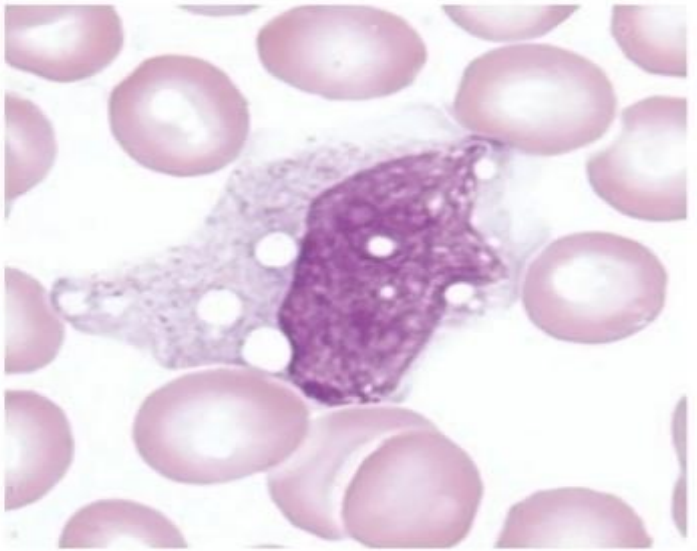
SIZE: 12-18 μm
NUCLEUS: Round to oval; may be irregularly shaped
Nucleoli: 1-2; may not be visible
Chromatin: Fine
Cytoplasm: Light blue to gray
GRANULES: None
N/C RATIO: 4:1
REFERENCE INTERVAL:
Bone Marrow: Not defined
Peripheral Blood: None



A

FIGURE 6–4A Promonocyte.

SIZE: 12-20 μm
NUCLEUS: Irregularly shaped; folded; may have brainlike convolutions
Nucleoli: May or may not be visible
Chromatin: Fine to lacy
Cytoplasm: Light blue to gray
GRANULES: Fine azurophilic (burgundy colored)
N/C RATIO: 2-3:1
REFERENCE INTERVAL:
Bone Marrow: <1%
Peripheral Blood: 0%



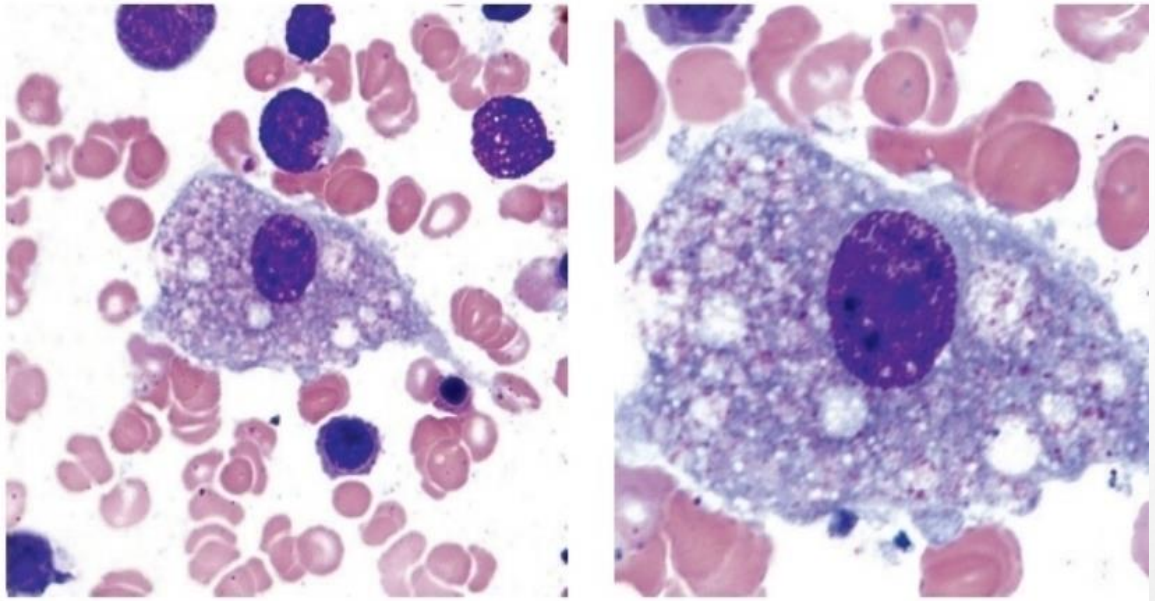
A

FIGURE 6–6A Monocyte.

SIZE: 12-20 μm
NUCLEUS: Variable; may be round, horseshoe shaped, or kidney shaped; often has folds producing "brainlike" convolutions
Nucleoli: Not visible
Chromatin: Lacy
CYTOPLASM: Blue-gray; may have pseudopods
Granules: Many fine granules frequently giving the appearance of ground glass
Vacuoles: Absent to numerous
N/C RATIO: Variable
REFERENCE INTERVAL:
Bone Marrow: 2%
Peripheral Blood: 3% to 11%

Refer to Table 1-1 for more examples.

MACROPHAGE (HISTIOCYTE)

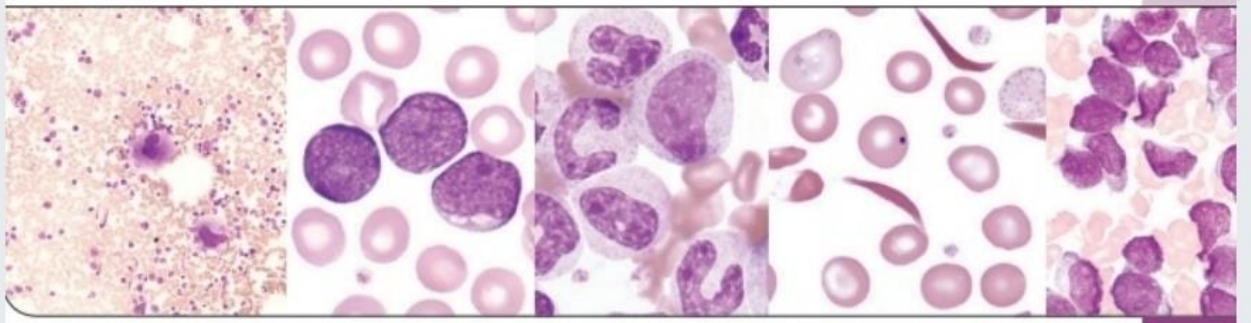


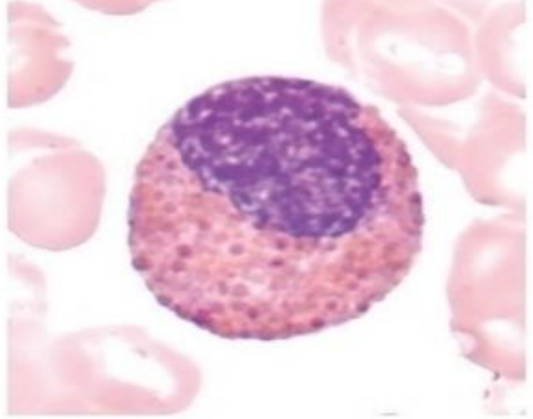
A B

FIGURE 6–8 Macrophage. Bone marrow **(A)** (×500), **(B)** (×1000).

SIZE: 15-80 μm
NUCLEUS: Eccentric, kidney or egg-shaped, indented, or elongated
Nucleoli: 1-2
Chromatin: Fine, dispersed
CYTOPLASM: Abundant with irregular borders; may contain ingested material
Granules: Many coarse azurophilic (burgundy-colored)
Vacuoles: May be present
REFERENCE INTERVAL: Macrophages reside in tissues, such as bone marrow, spleen, liver, lungs, and others. Rarely, they are seen in the peripheral blood during severe sepsis.

EOSINOPHIL MATURATION





A

FIGURE 7–2A Eosinophilic myelocyte.

SIZE: 12-18 μm
NUCLEUS: Round to oval; may have one flattened side
Nucleoli: Usually not visible
Chromatin: Coarse and more condensed than promyelocyte
CYTOPLASM: Colorless to pink
Granules:
Primary: Few to moderate
Secondary: Variable number; pale orange to dark orange; round; appear refractile
N/C RATIO: 2:1 to 1:1
REFERENCE INTERVAL:
Bone Marrow: 0% to 2%
Peripheral Blood: 0%
NOTE: This chapter begins with the image of the myelocyte, rather than the blast, because it is at the myelocyte stage that secondary granules, which define a cell as an eosinophil, first appear.

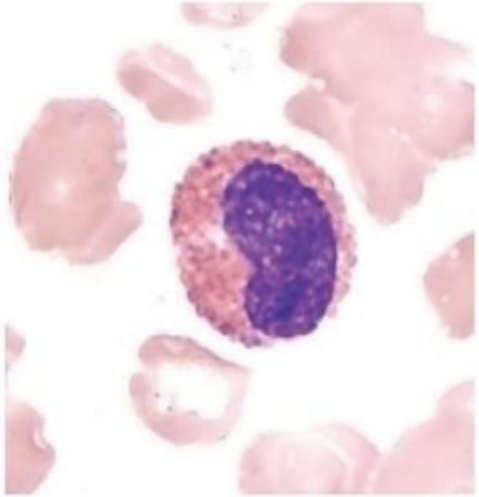


FIGURE 7–4 Eosinophilic metamyelocyte.

SIZE: 10-15 μm
NUCLEUS: Indented; kidney bean shape; indentation is less than 50% of the width of the hypothetical round nucleus
Nucleoli: Not visible
Chromatin: Coarse, clumped
CYTOPLASM: Colorless
Granules:
Primary: Few
Secondary: Many pale orange to dark orange; appear refractile
N/C RATIO: 1.5:1
REFERENCE INTERVAL:
Bone Marrow: 0% to 2%
Peripheral Blood: 0%

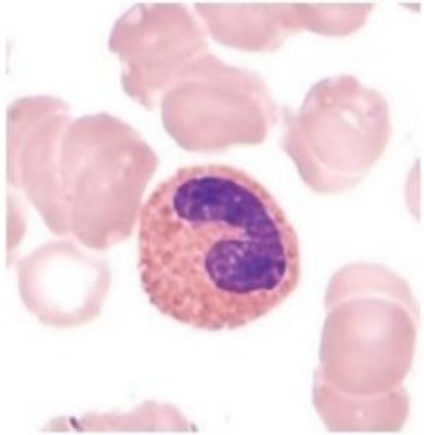
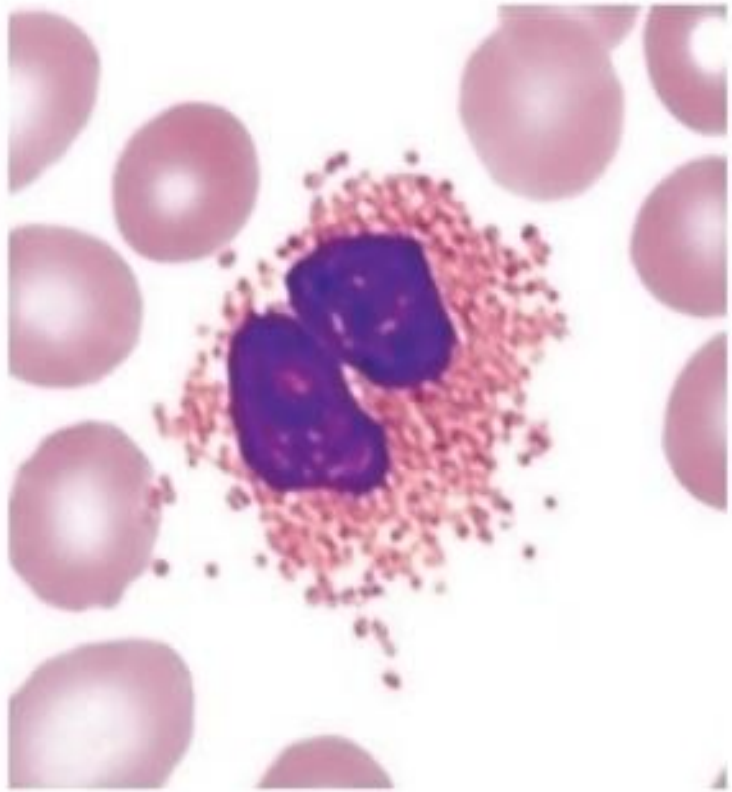


FIGURE 7–6 Eosinophilic band.

SIZE: 10-15 μm
NUCLEUS: Constricted but no threadlike filament: indentation is more than 50% of the width of a hypothetical round nucleus
NOTE: Chromatin must be visible in constriction
Nucleoli: Not visible
Chromatin: Coarse, clumped
CYTOPLASM: Colorless, cream-colored
Granules:
Primary: Few
Secondary: Abundant pale to dark orange; appear refractile
N/C RATIO: Cytoplasm predominates
REFERENCE INTERVAL:
Bone Marrow: 0% to 2%
Peripheral Blood: Rarely seen

A

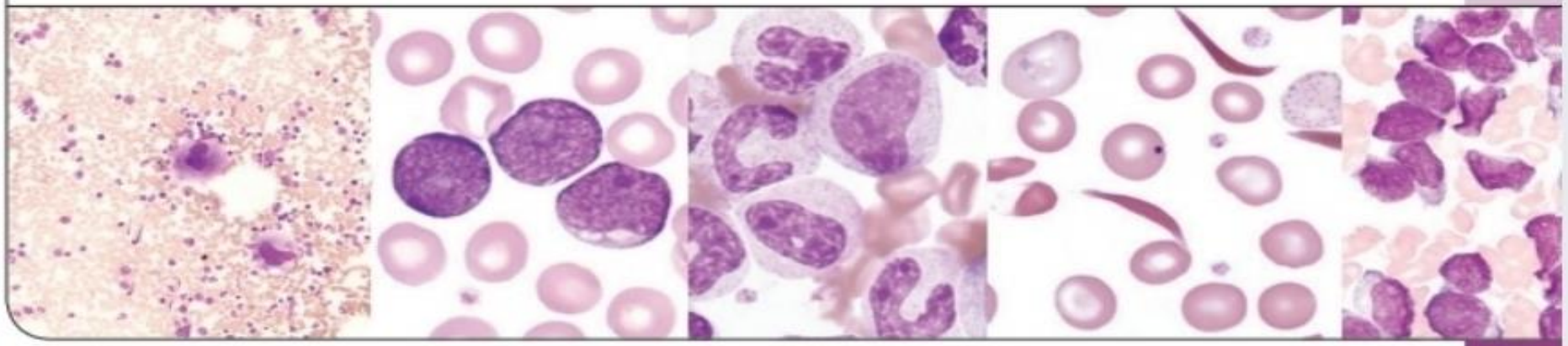
FIGURE 7–8A Eosinophil.



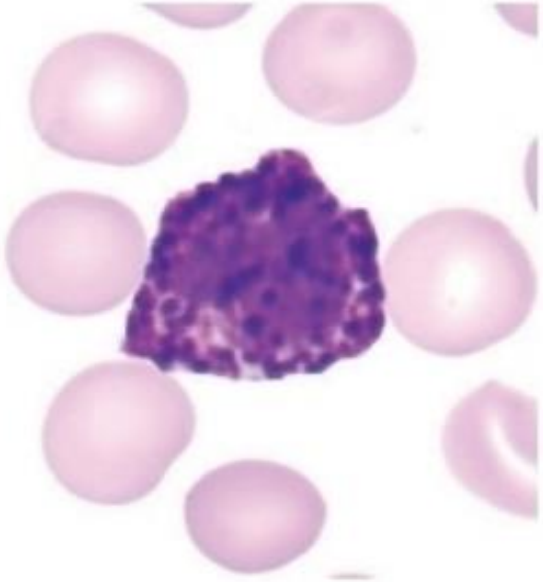
B

FIGURE 7–8B Fractured eosinophil.

BASOPHIL MATURATION

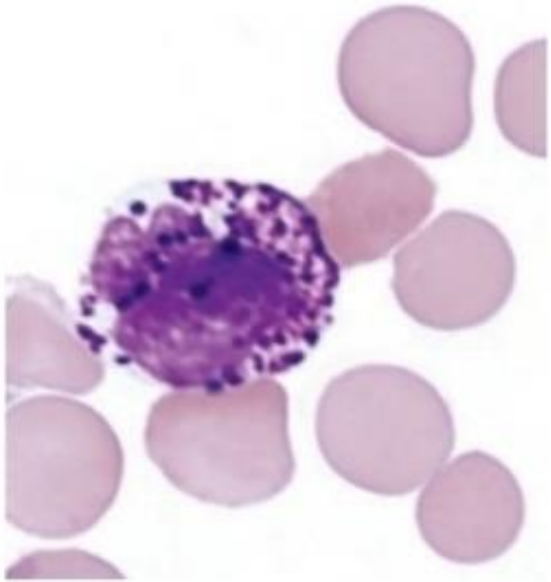


BASOPHIL



A

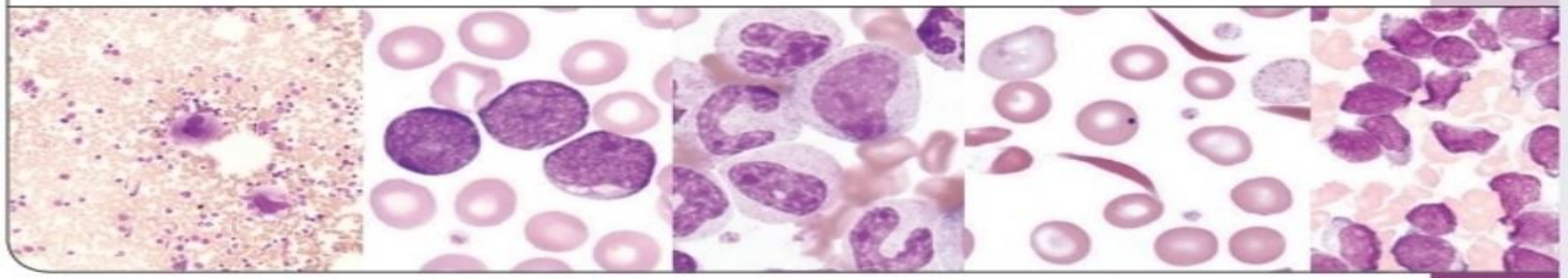
FIGURE 8–2A Basophil.

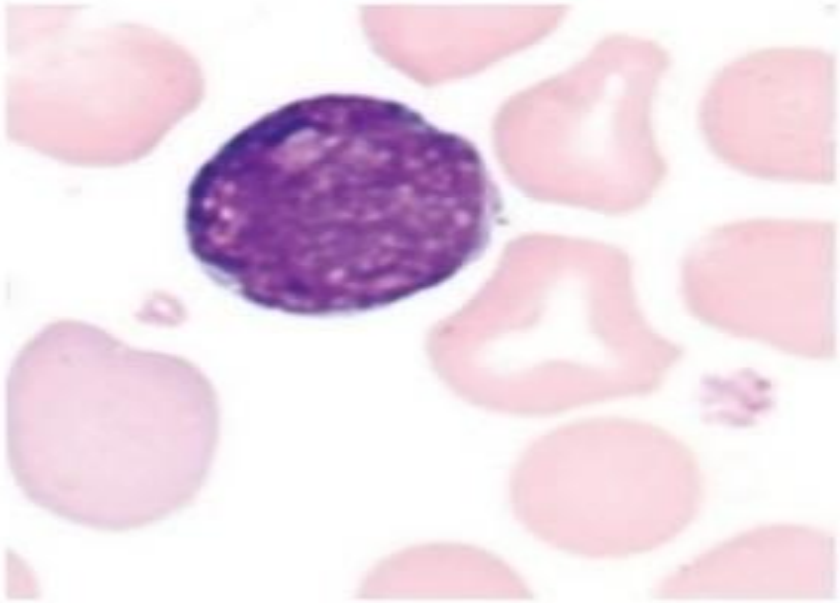


B

FIGURE 8–2B Basophil. Note that granules are water-soluble and may be dissolved during the staining process, leaving clear area in the cytoplasm.

LYMPHOCYTE MATURATION

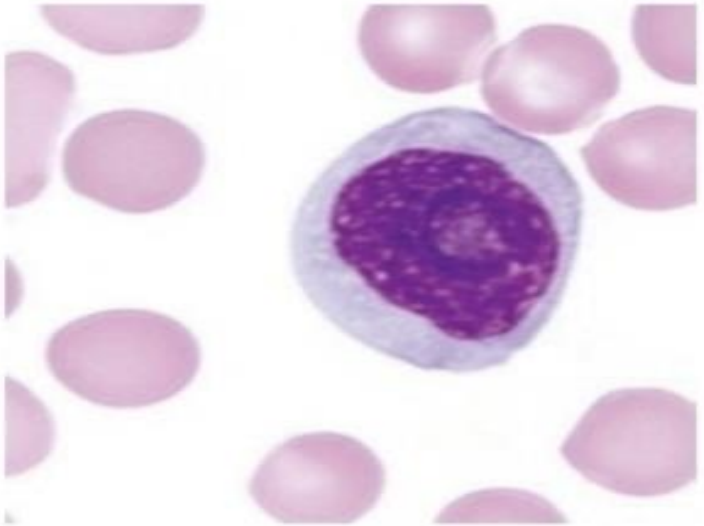




A

FIGURE 9–2A Lymphoblast.

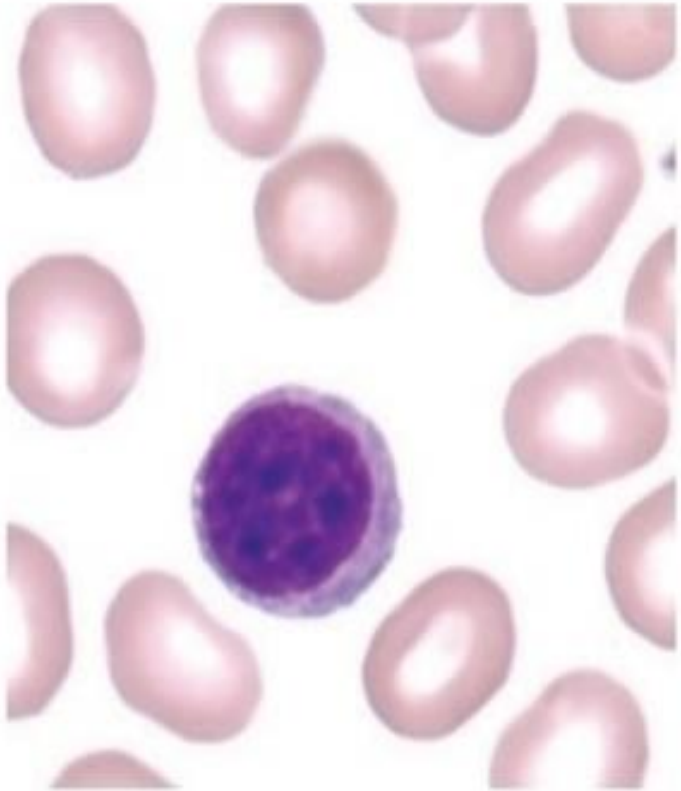
SIZE: 10-20 μm
NUCLEUS: Round to oval
Nucleoli: ≥1
Chromatin: Fine, evenly stained
CYTOPLASM: Scant; slightly to moderately basophilic
Granules: None
N/C RATIO: 7:1 to 4:1
REFERENCE INTERVAL:
Bone Marrow: Not defined
Peripheral Blood: 0%



A

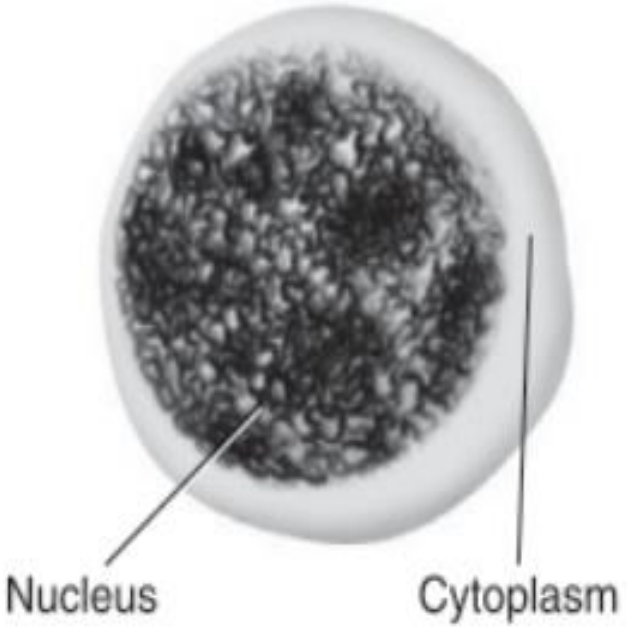
FIGURE 9–4A Prolymphocyte.

SIZE: 9-18 μm
NUCLEUS: Round or indented
Nucleoli: 0-1; usually single, prominent, large nucleolus
Chromatin: Slightly clumped; intermediate between lymphoblast and mature lymphocyte
CYTOPLASM: Light blue
Granules: None
N/C RATIO: 3-4:1
REFERENCE INTERVAL:
Bone Marrow: Not defined
Peripheral Blood: None



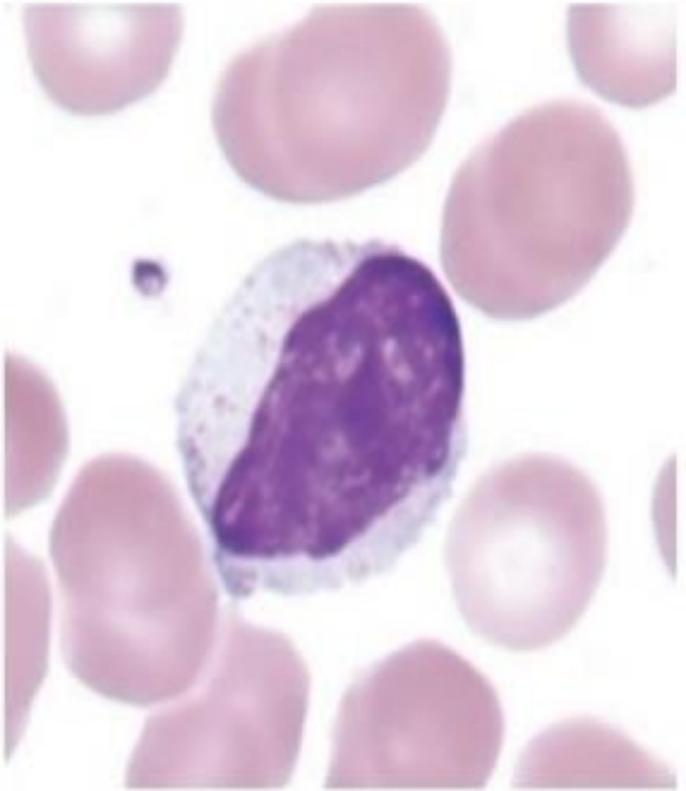
A

FIGURE 9–6A Small lymphocyte.



B

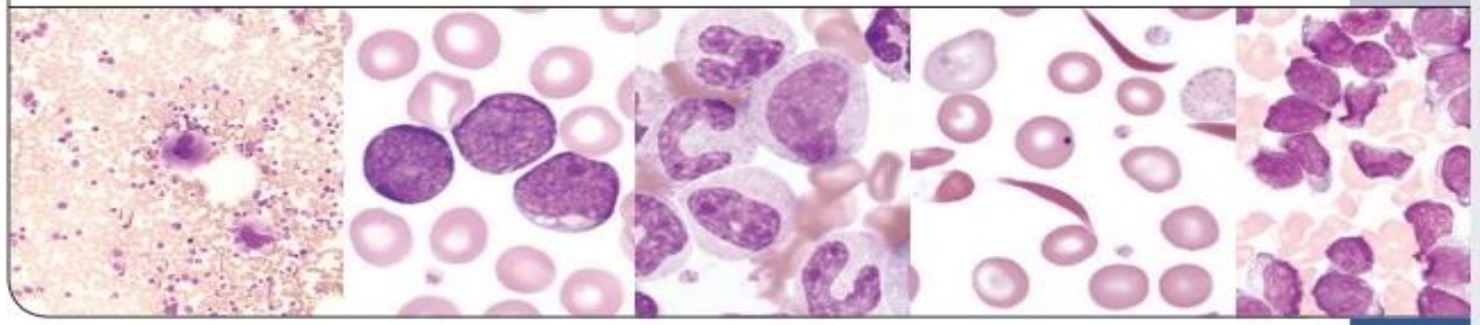
FIGURE 9–6B Schematic of lymphocyte.



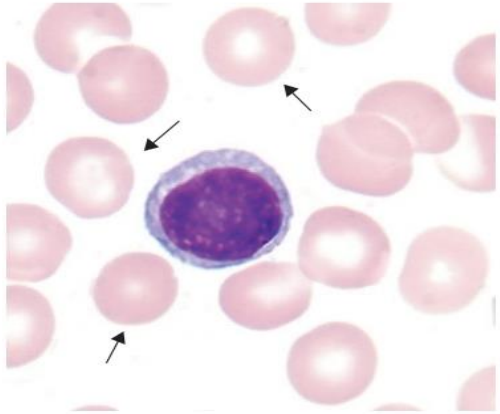
C

FIGURE 9–6C Large lymphocyte. Note irregular nucleus and more abundant cytoplasm than small lymphocyte.

VARIATIONS IN SIZE AND COLOR OF ERYTHROCYTES



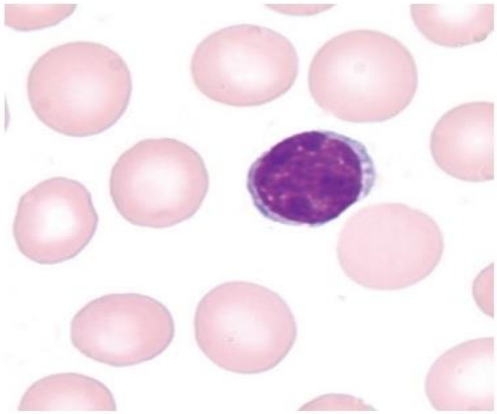
VARIATIONS IN SIZE



A

FIGURE 10–1A Microcytes (MCV < 80 fL.).

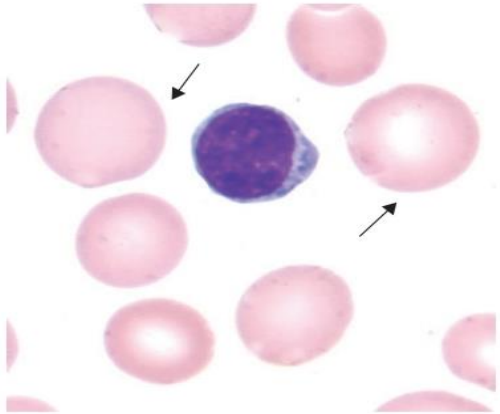
Associated with: Iron deficiency anemia, thalassemia minor, chronic inflammation (some cases), lead poisoning, hemoglobinopathies (some), sideroblastic anemia



B

FIGURE 10–1B Normocytes (MCV 80–100 fL.).

Normal erythrocytes are approximately the same size as the nucleus of a small lymphocyte.



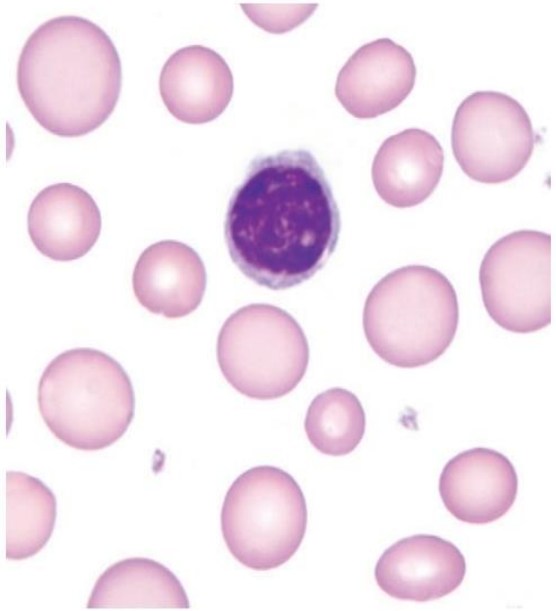
C

FIGURE 10–1C Macrocytes (MCV > 100 fL.).

Associated with: Liver disease, vitamin B_{12} deficiency, folate deficiency, neonates, reticulocytosis

Anisocytosis is the variation in red blood cell (RBC) diameter (or RBC volume) on a blood film. This variation correlates with the electronically determined red blood cell distribution width (RDW). An RDW greater than 14.5% indicates a heterogenous population of RBCs and a variety of sizes of RBCs should be seen. A low RDW is of no significance.

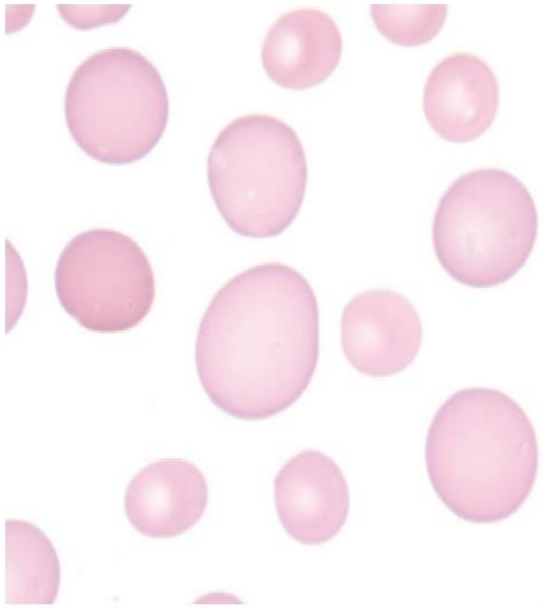
ANISOCYTOSIS



A

FIGURE 10–2A Heterogeneous population of erythrocytes, indicating anisocytosis (RDW > 14.5%).

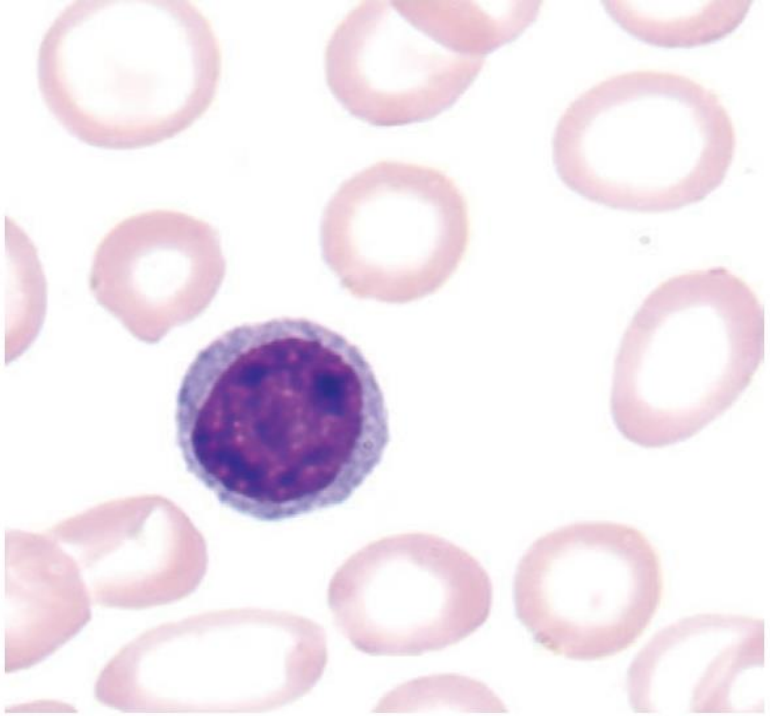
Associated with: Anemias, especially iron deficiency, megaloblastic and hemolytic



B

FIGURE 10–2B When two distinct populations of RBCs are seen, it is termed a dimorphic population (RDW > 14.5%).

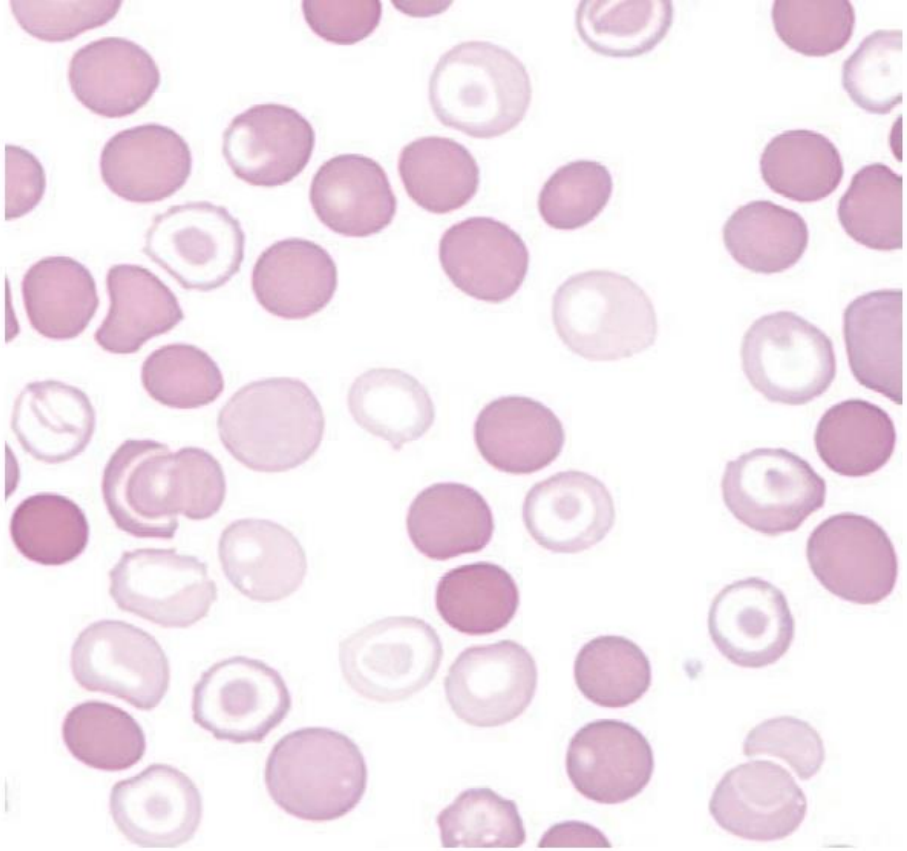
Associated with: Transfusion, myelodysplastic syndromes, vitamin B_{12}, folate, or iron deficiencies—early in treatment process



A

FIGURE 10–3A Hypochromia. The central pallor zone of the erythrocyte must be greater than one-third of the diameter of the cell before it is classified as hypochromic. (Note: the MCHC, not the MCH, should be used as a gauge of hypochromia; however, the MCHC is not always decreased when few hypochromic cells are seen.)

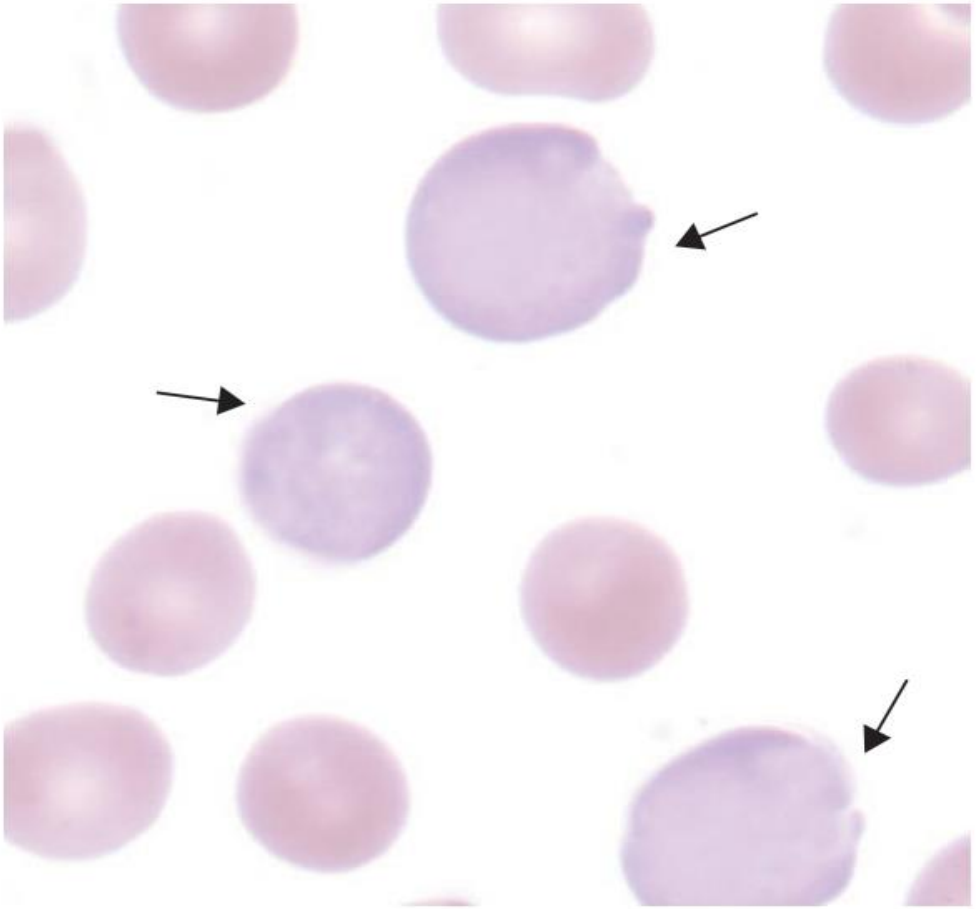
Associated with: Iron deficiency anemia, thalassemias, sideroblastic anemia, lead poisoning, some cases of anemia of chronic inflammation.



B

FIGURE 10–3B Dichromic population of erythrocytes. (Two populations of RBCs are shown: one normochromic and one hypochromic.)

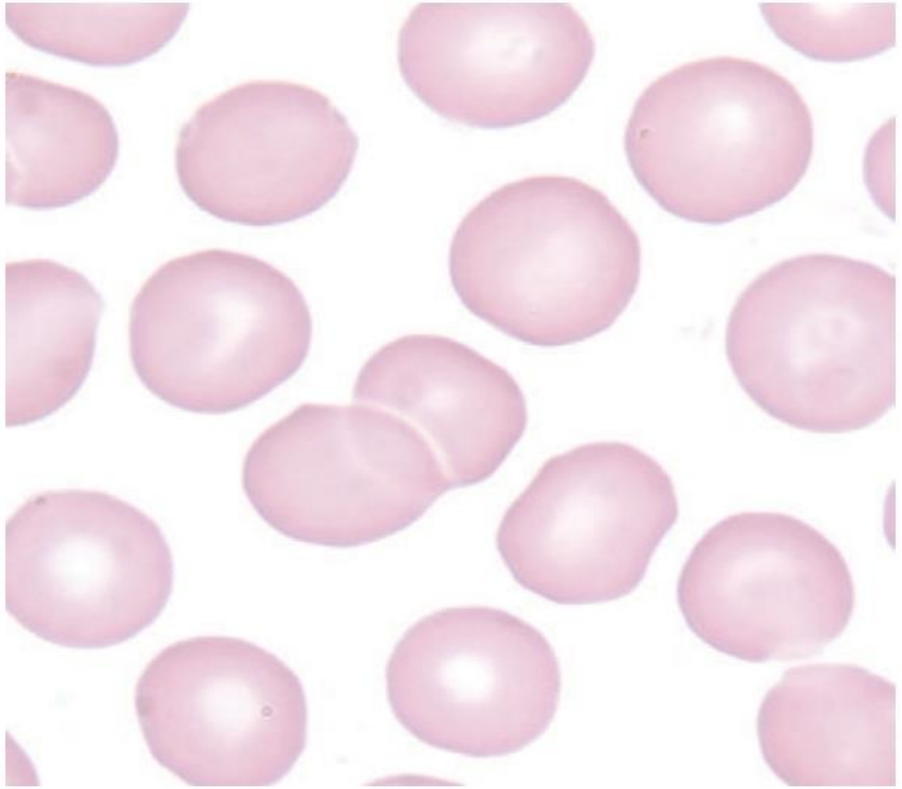
Associated with: Transfusions, sideroblastic anemia.



C

FIGURE 10–3C Polychromasia; retained RNA in RBCs.

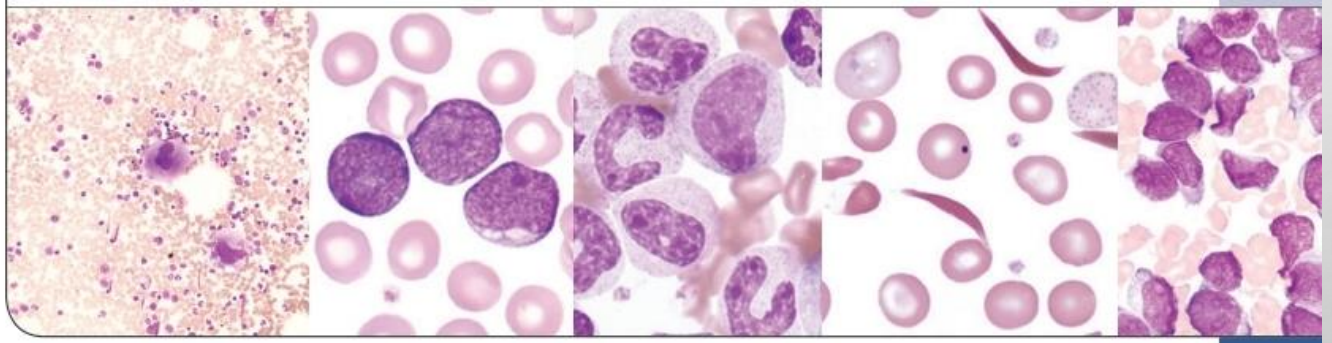
Associated with: Acute and chronic hemorrhage, hemolysis, effective treatment for anemia, neonates.



D

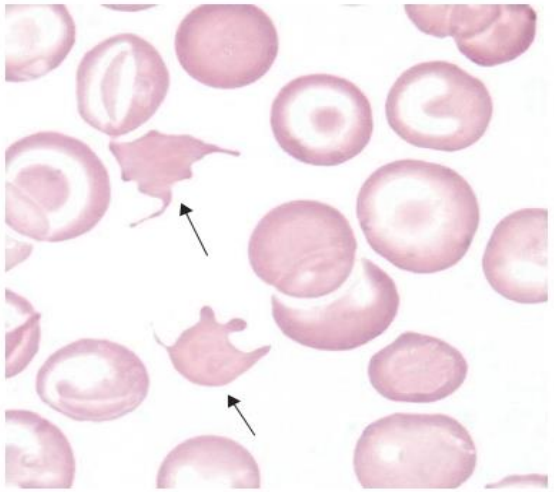
FIGURE 10–3D Normochromic erythrocytes. (MCHC 32–36 g/dL or 32%–36%.) For comparison with hypochromic and polychromatic erythrocytes.

VARIATIONS IN SHAPE AND DISTRIBUTION OF ERYTHROCYTES



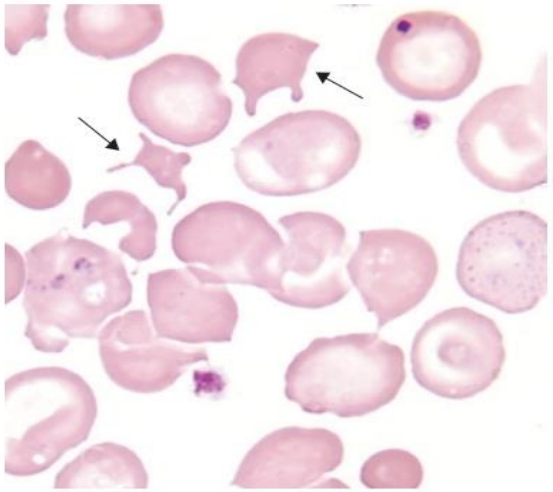
ACANTHOCYTE

Spur Cell



A

FIGURE 11–1A Acanthocytes.

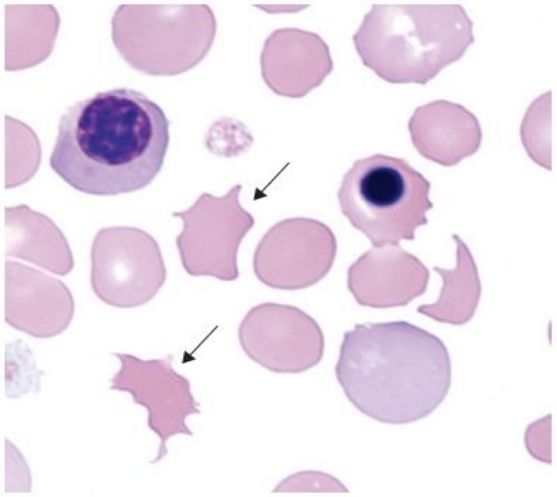


B

FIGURE 11–1B Acanthocytes.

DESCRIPTION: Erythrocyte with irregularly spaced projections that vary in width, length, and number usually dense, lacking central pallor

Associated with: Severe liver disease, splenectomy, malabsorption, hypothyroidism, vitamin E deficiency abetalipoproteinemia

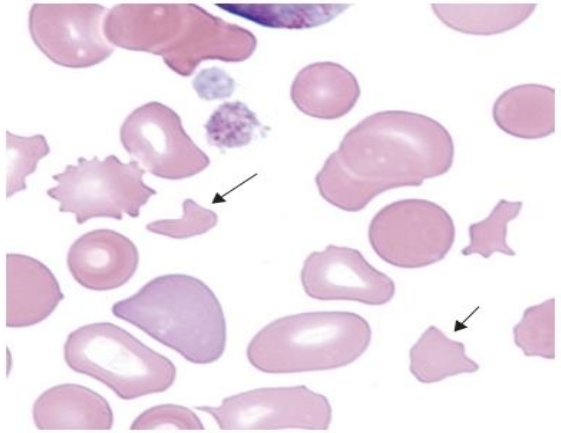


C

FIGURE 11–1C Acanthocytes; two nucleated red blood cells in field.

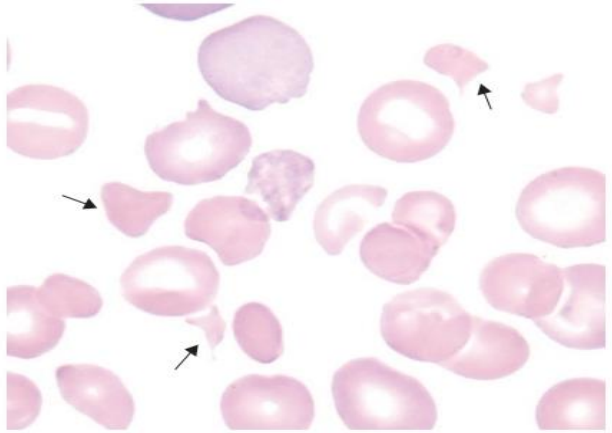
SCHISTOCYTE

Schizocyte



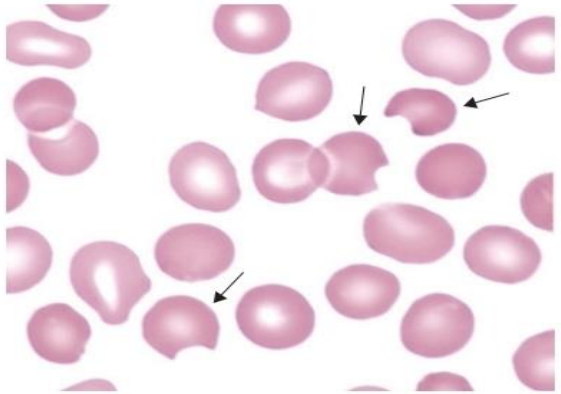
A

FIGURE 11–2A Schistocytes.



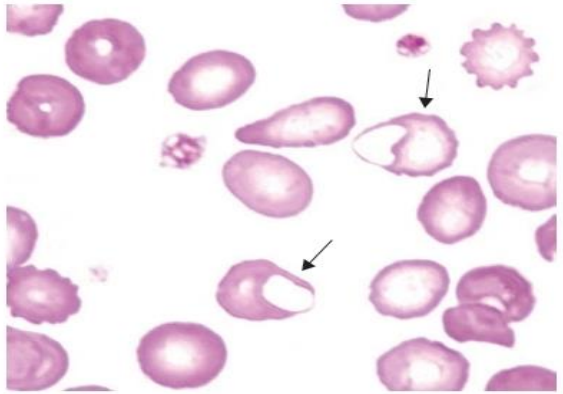
B

FIGURE 11–2B Schistocytes.



C

FIGURE 11–2C Bite cells.



D

FIGURE 11–2D Blister cells.

COLOR: Red to salmon

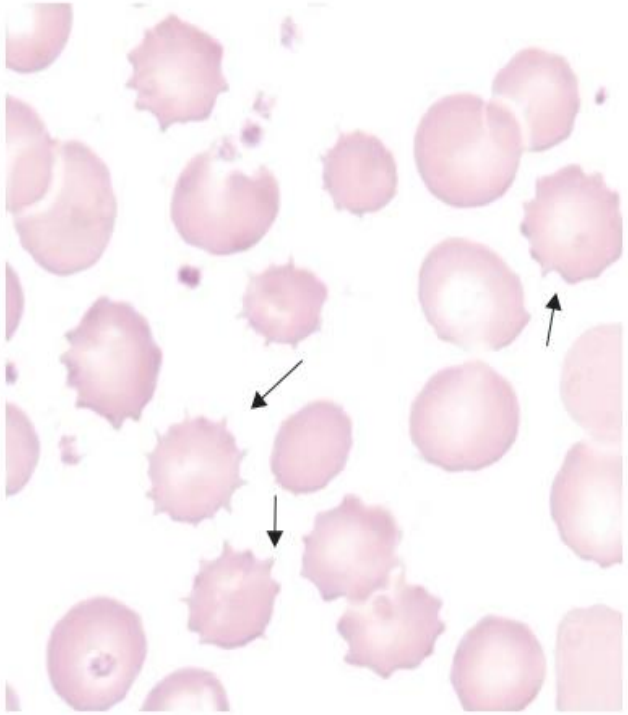
SHAPE: Fragmented erythrocytes; many sizes and shapes may be present on a smear; often display pointed extremities

Associated with: Microangiopathic hemolytic anemia (hemolytic uremic syndrome, thrombotic thrombocytopenic purpura, disseminated intravascular coagulation), severe burns, renal graft rejection

NOTE: Bite and blister cells are the result of splenic pitting of Heinz bodies (see Figure 12-5, *B*). These cells are often included in the schistocyte category.

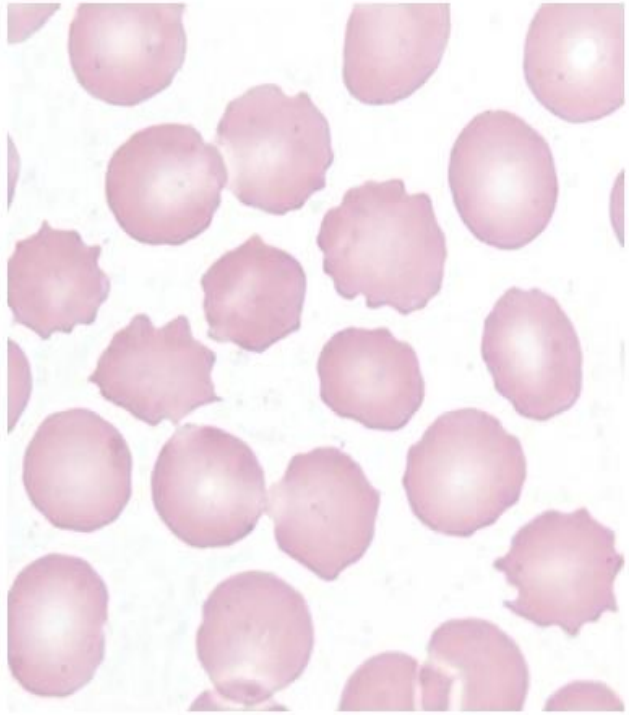
ECHINOCYTE

Burr Cell



A

FIGURE 11–3A Echinocytes/burr cells.



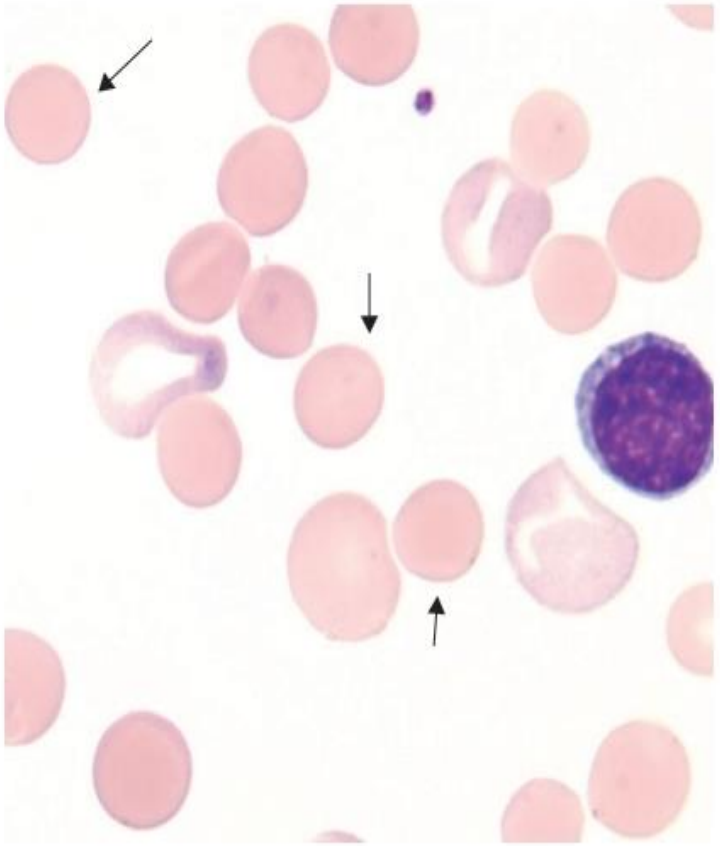
B

FIGURE 11–3B Echinocytes/burr cells.

DESCRIPTION: Erythrocyte with short, evenly spaced projections usually with central pallor

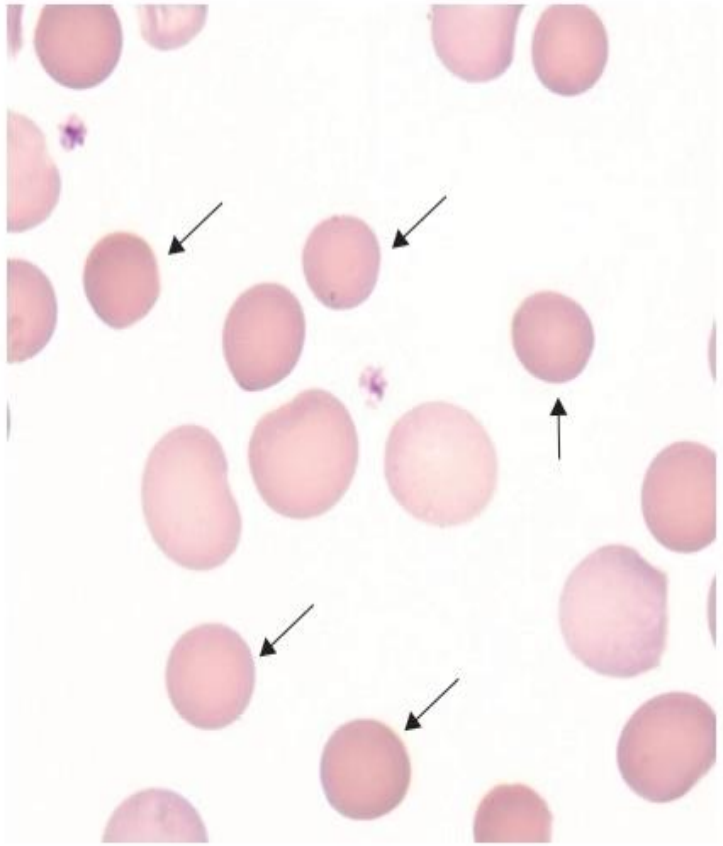
Associated with: Uremia, pyruvate kinase deficiency, microangiopathic hemolytic anemia, neonates (especially premature), artifact

SPHEROCYTE



A

FIGURE 11–4A Spherocytes.



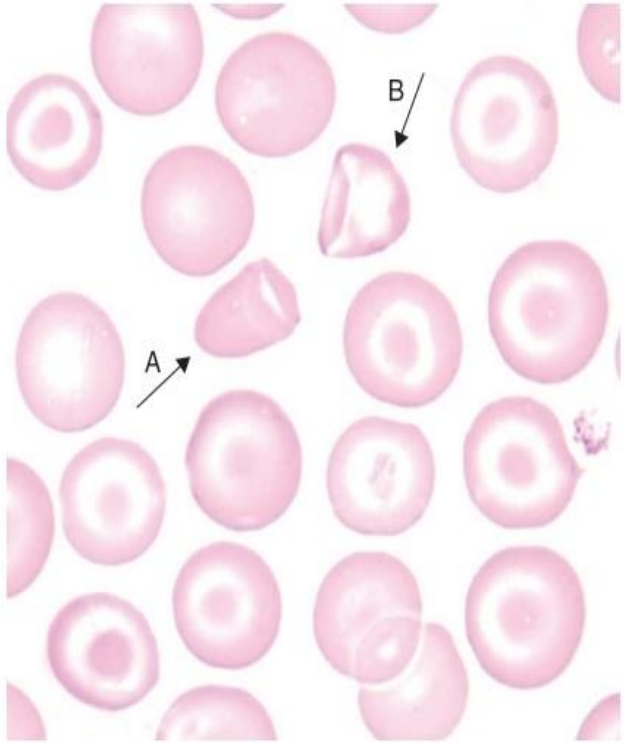
B

FIGURE 11–4B Spherocytes.

COLOR: Darker than surrounding red blood cells
SHAPE: Round; no central pallor zone
Associated with: Hereditary spherocytosis, some hemolytic anemias, transfused cells, severe burns

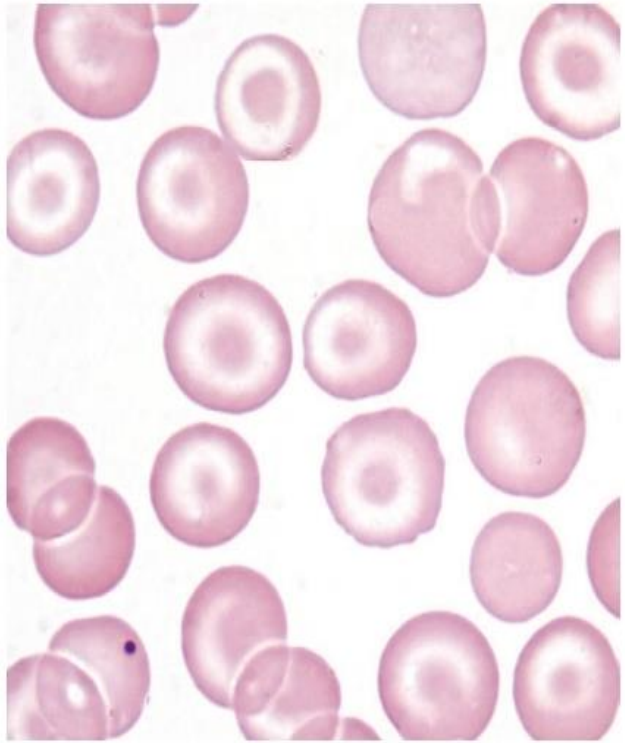
TARGET CELL

Codocyte



A

FIGURE 11–5A Target cells.



B

FIGURE 11–5B Target cells.

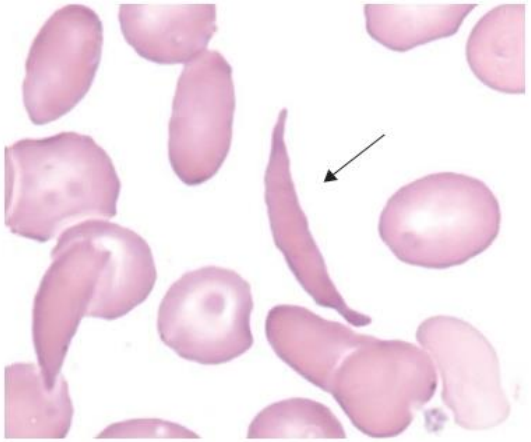
COLOR: Red to salmon

SHAPE: Bull's eye; central concentration of hemoglobin surrounded by colorless area with peripheral ring of hemoglobin resembling bull's eye; may be bell (Figure 11-5, *A*, *arrow A*) or cup (see Figure 11-5, *A*, *arrow B*) shaped.

Associated with: Hemoglobinopathies, thalassemia, iron deficiency anemia, splenectomy, obstructive liver disease

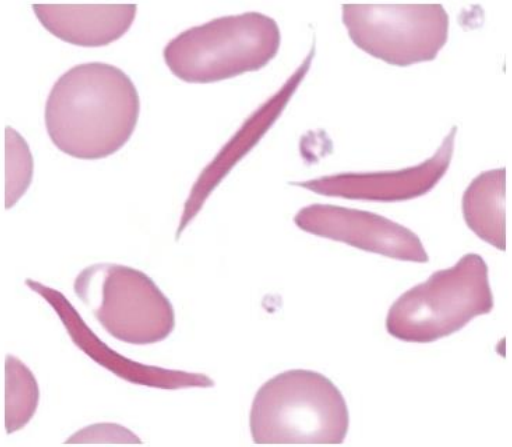
SICKLE CELL

Drepanocyte



A

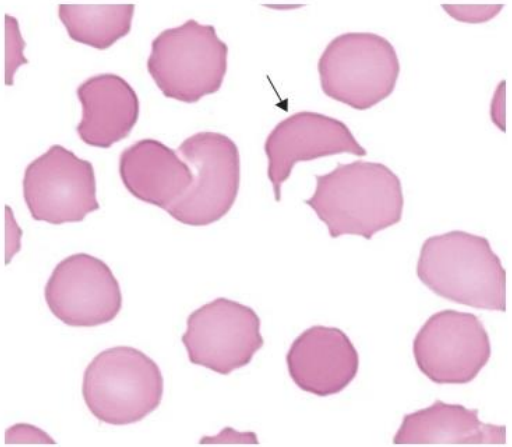
FIGURE 11–6A Sickle cells.



B

FIGURE 11–6B Sickle cells.

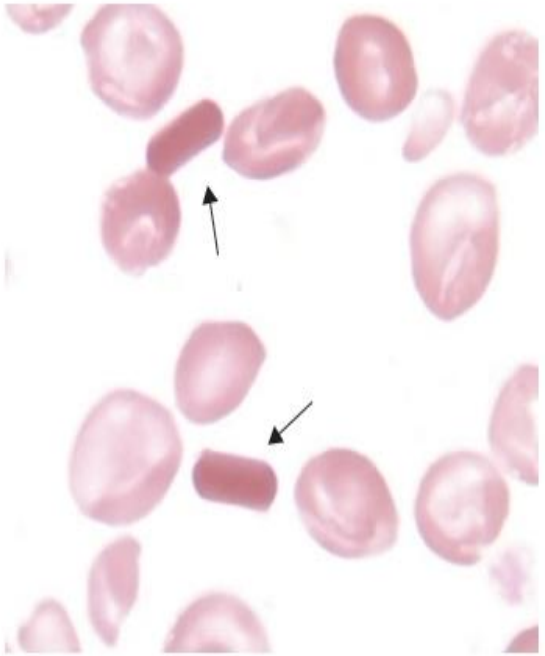
COLOR: Dark red to salmon, lacks central pallor
SHAPE: Elongated cell with point on each end; may be curved or S-shaped
COMPOSITION: Hemoglobin S
Associated with: Homozygous hemoglobin S disease, sometimes hemoglobin SC



C

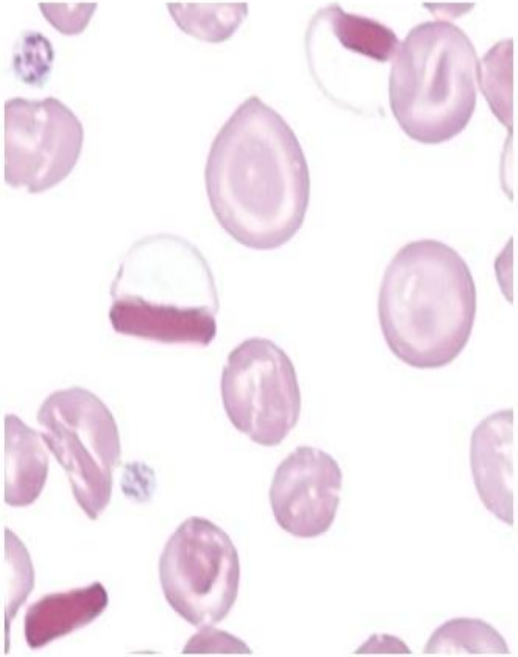
FIGURE 11–6C Schistocyte resembling sickle cell. (Note: Central area is markedly thicker than the ends.)

HEMOGLOBIN C CRYSTAL



A

FIGURE 11–7A Hemoglobin CC crystals.

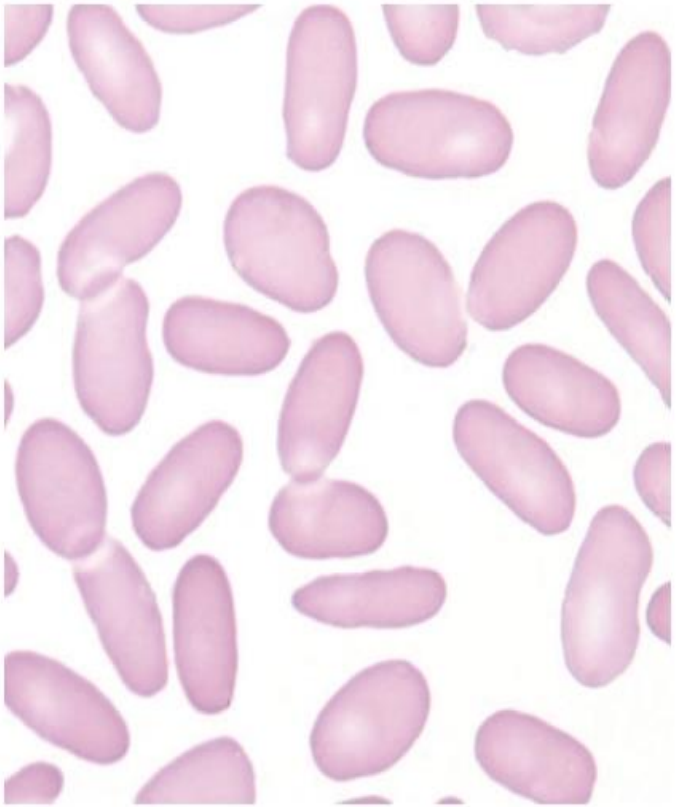


B

FIGURE 11–7B Hemoglobin CC crystals with visible red blood cell membrane.

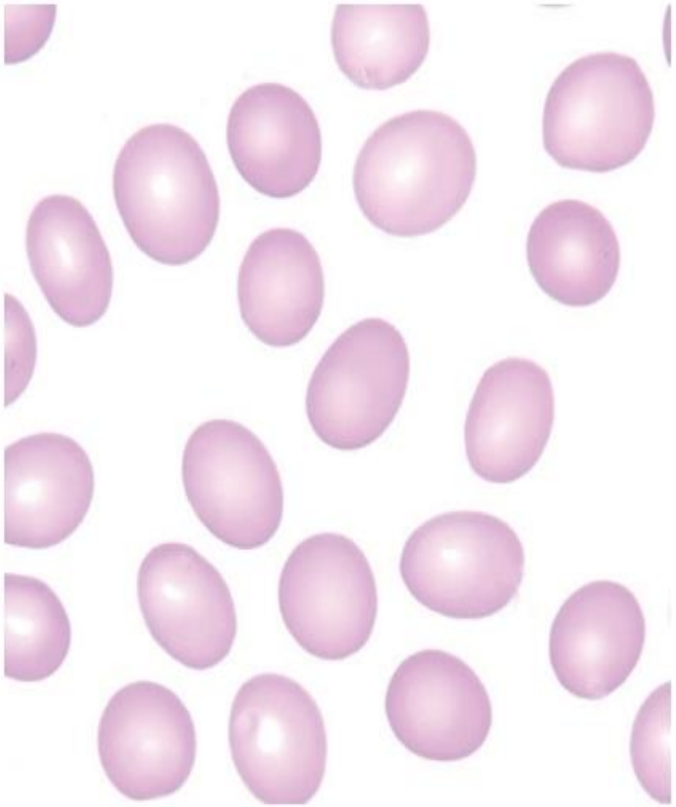
COLOR: Dark red
SHAPE: Hexagonal
NUMBER PER CELL: 1
COMPOSITION: Hemoglobin C
Associated with: Homozygous hemoglobin C disease

ELLIPTOCYTE/OVALOCYTE



A

FIGURE 11–9A Elliptocytes.



B

FIGURE 11–9B Ovalocytes.

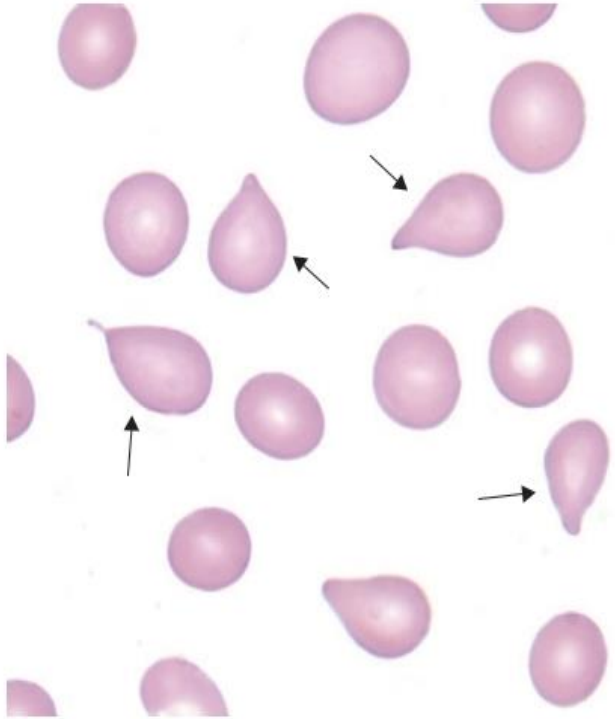
DESCRIPTION: Elliptocyte—cigar-shaped erythrocyte

DESCRIPTION: Ovalocyte—egg-shaped erythrocyte

Associated with: Hereditary elliptocytosis or ovalocytosis, thalassemia major, iron deficiency anemia, megaloblastic anemias (macro-ovalocytes), myelophthisic anemias

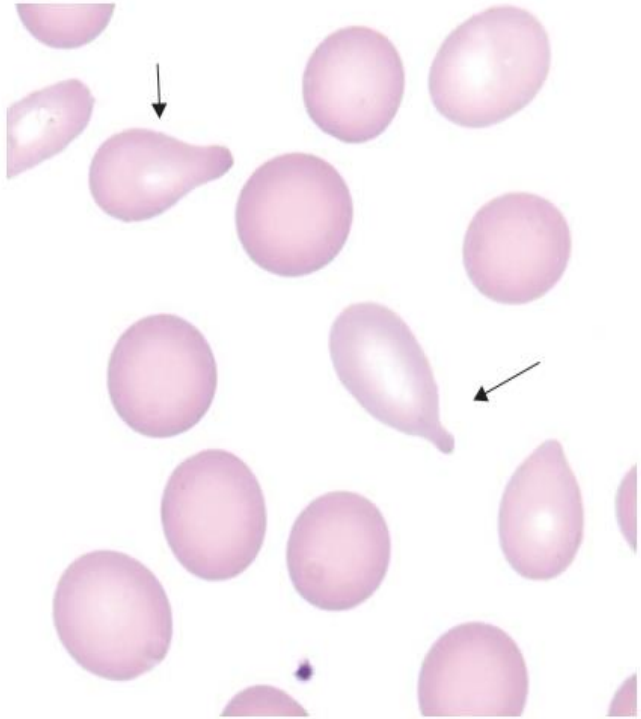
TEAR DROP CELL

Dacryocyte



A

FIGURE 11–10A Tear drop cells.



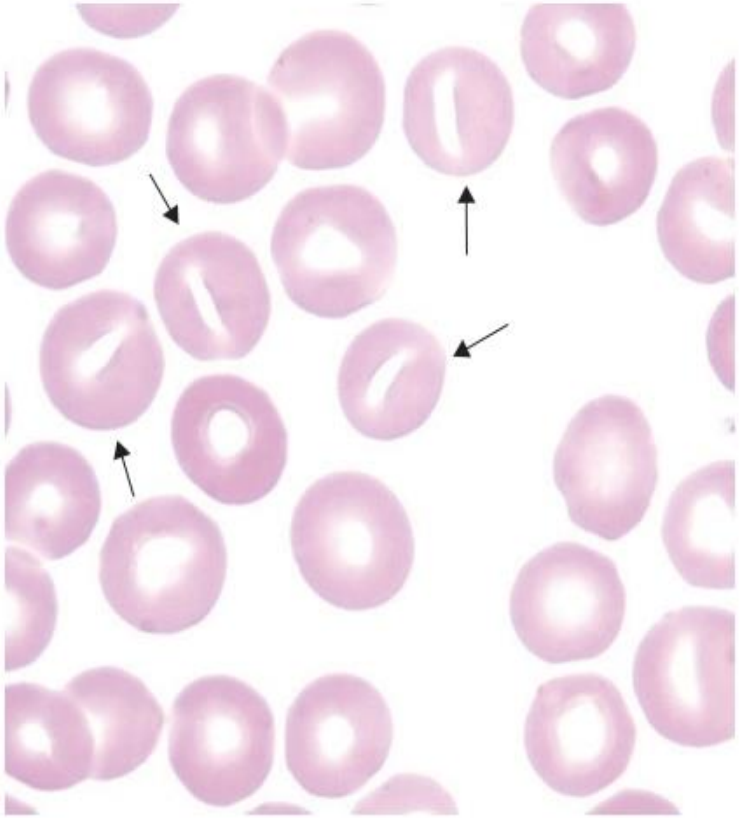
B

FIGURE 11–10B Tear drop cells.

DESCRIPTION: Erythrocyte shaped like a tear drop or pear; may have one blunt projection

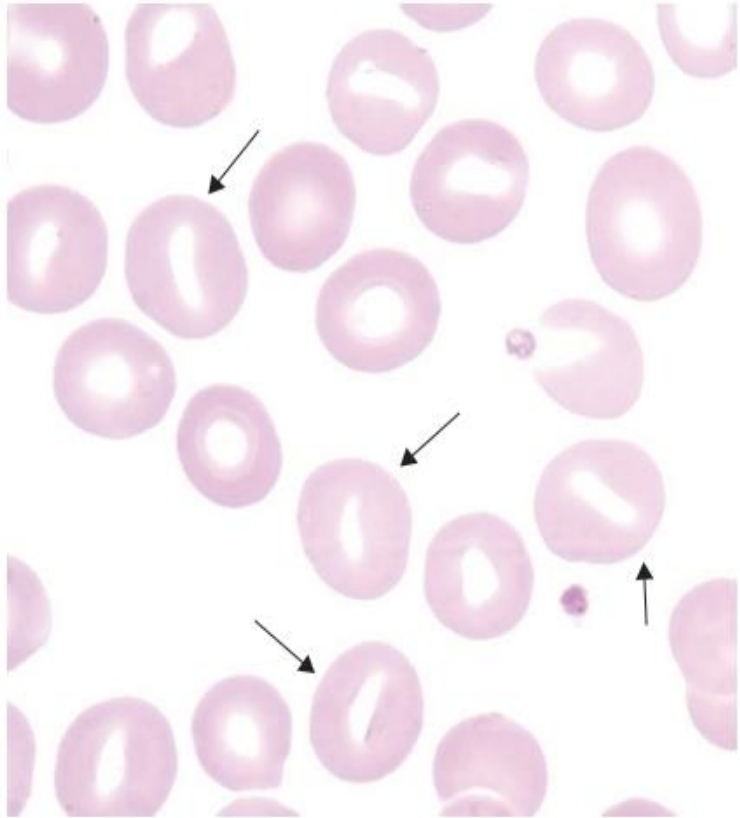
Associated with: Primary myelofibrosis, thalassemia, myelophthisic anemia, other causes of extramedullary hematopoiesis

STOMATOCYTE



A

FIGURE 11–11A Stomatocytes.



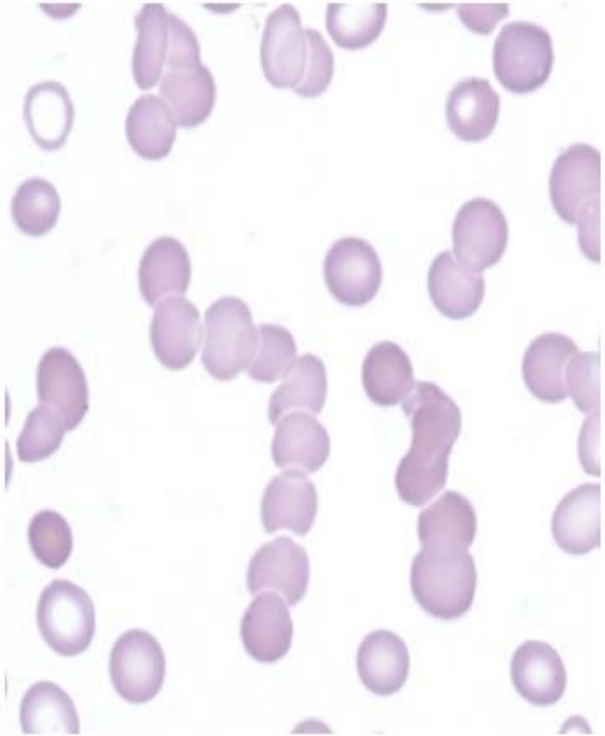
B

FIGURE 11–11B Stomatocytes.

DESCRIPTION: Erythrocyte with slitlike area of central pallor (similar to a mouth or stoma)

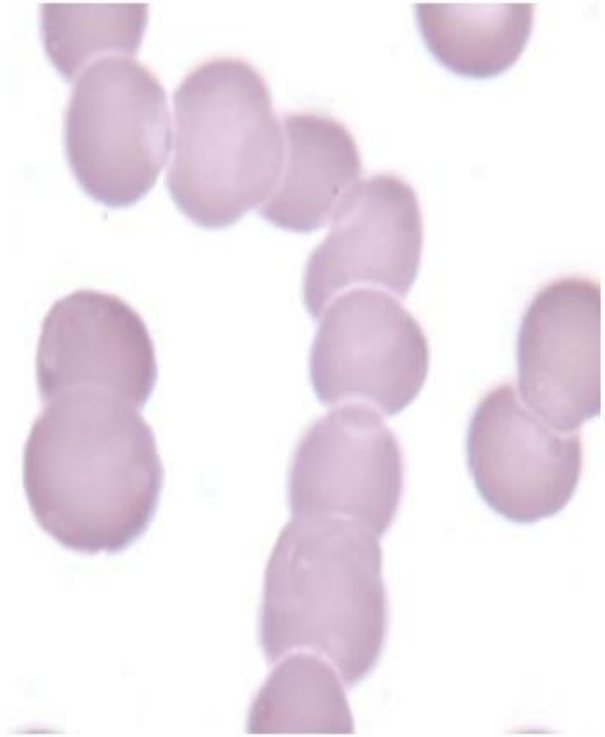
Associated with: Hereditary stomatocytosis, alcoholism, liver disease, Rh null phenotype, artifact

ROULEAUX VERSUS AUTOAGGLUTINATION



A

FIGURE 11–12A Rouleaux (×500).



B

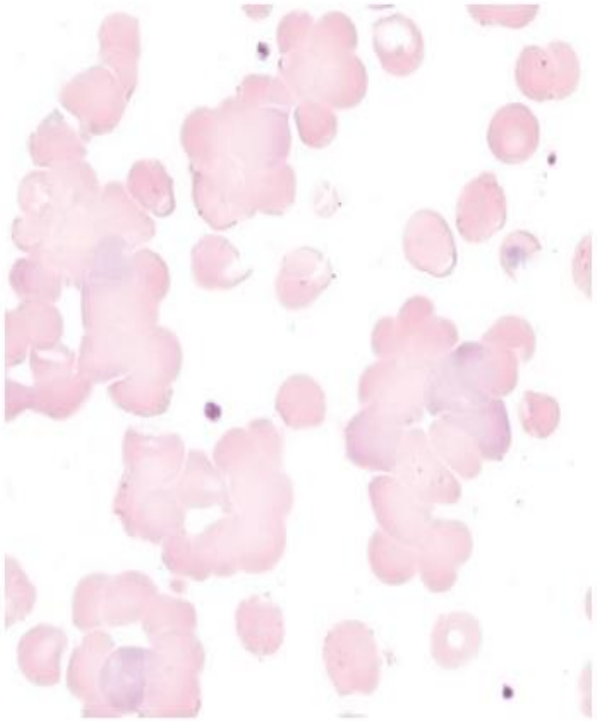
FIGURE 11–12B Rouleaux (×1000).

ROULEAUX

DESCRIPTION: Erythrocytes arranged in rows like stacks of coins; increased proteins in patients with rouleaux may make the background of the slide appear blue

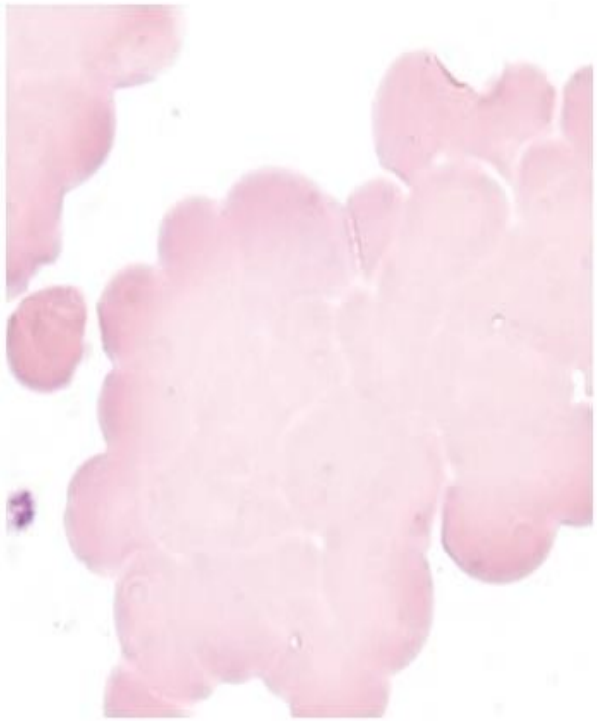
Associated with: Acute and chronic inflammatory disorders, plasma cell myeloma, lymphoplasmacytic lymphoma

NOTE: These aggregates will disperse with saline.



C

FIGURE 11–12C Autoagglutination (×500).



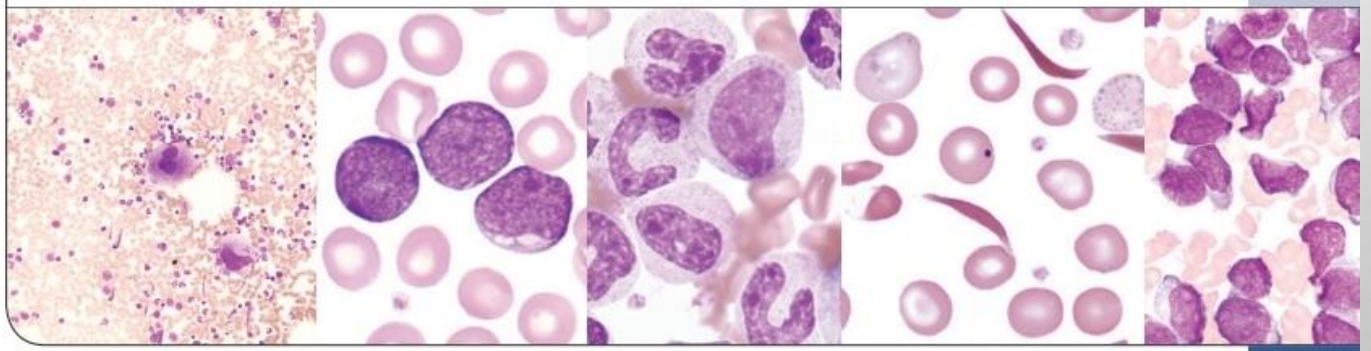
D

FIGURE 11–12D Autoagglutination (×1000).

AUTOAGGLUTINATION

DESCRIPTION: Clumping of erythrocytes; outlines of individual cells may not be evident
Associated with: Antigen-antibody reactions
NOTE: Aggregate will not disperse with saline.

INCLUSIONS IN ERYTHROCYTES



HOWELL-JOLLY BODIES

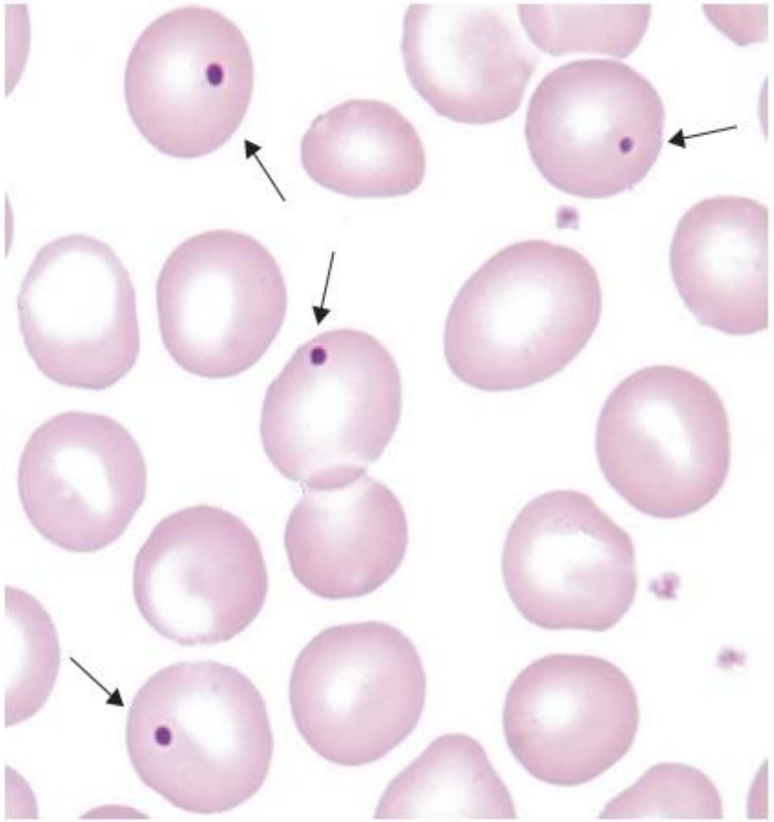
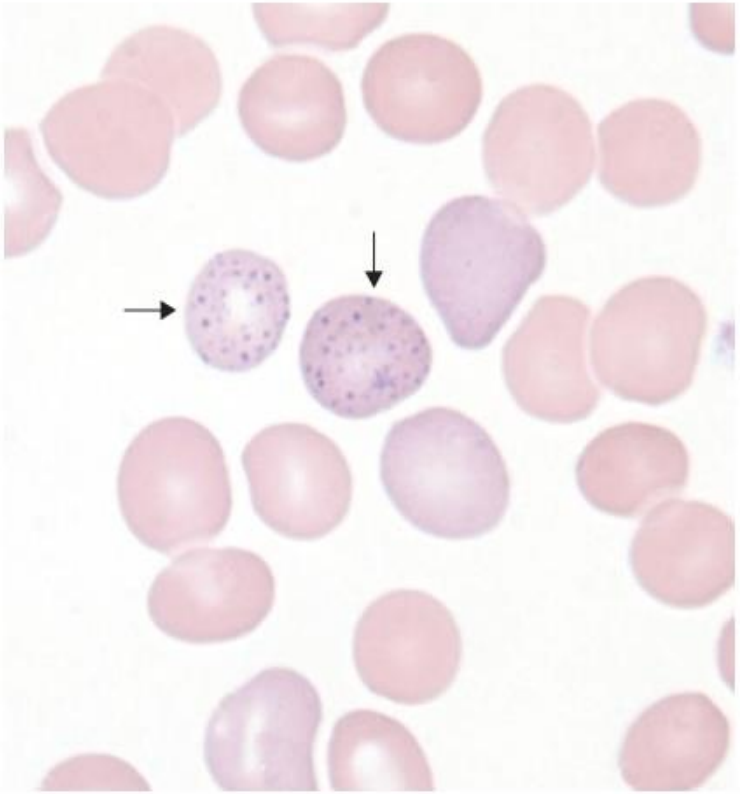


FIGURE 12–1 Howell-Jolly bodies.

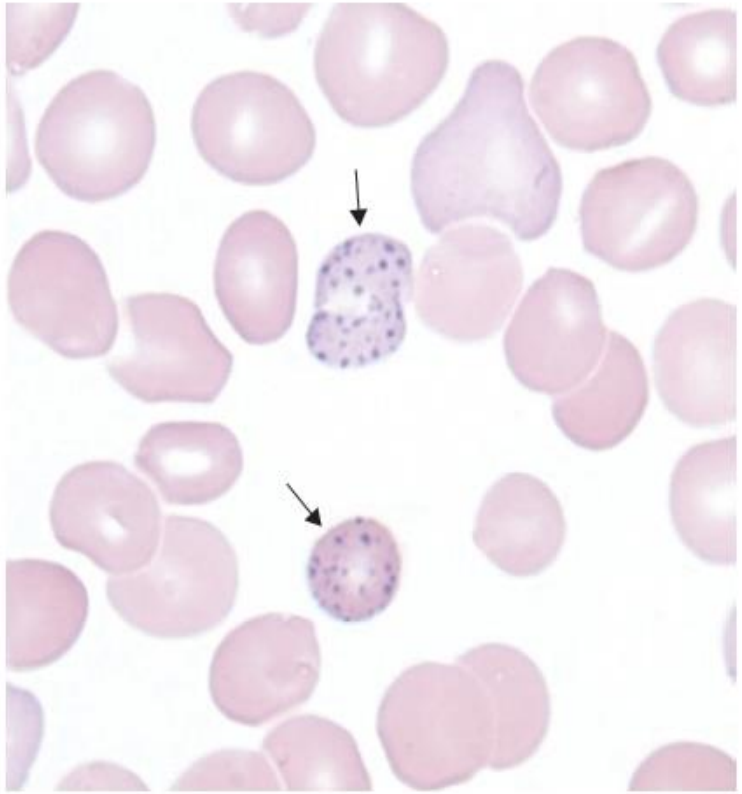
COLOR: Dark blue to purple
SHAPE: Round to oval
SIZE: 0.5-1.5 μm
NUMBER PER CELL: Usually 1; may be multiple
COMPOSITION: DNA
Associated with: Splenectomy, hyposplenism, megaloblastic anemia, hemolytic anemia

BASOPHILIC STIPPLING



A

FIGURE 12–2A Basophilic stippling.



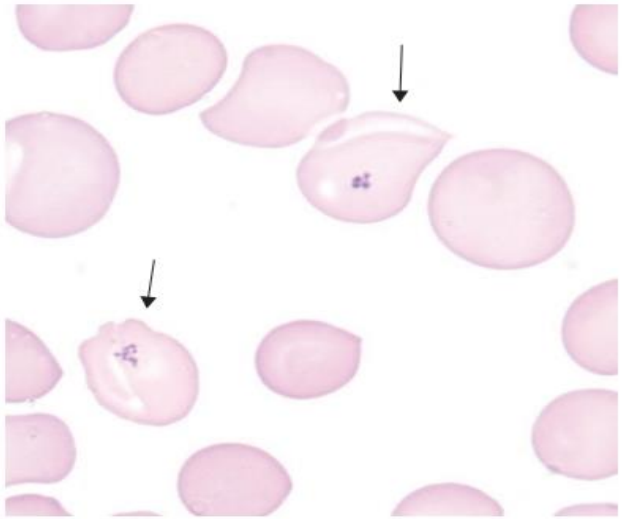
B

FIGURE 12–2B Basophilic stippling.

COLOR: Dark blue to purple
SHAPE: Fine or coarse punctate granules
NUMBER PER CELL: Numerous with fairly even distribution
COMPOSITION: RNA
Associated with: Lead intoxication, thalassemia, abnormal heme synthesis

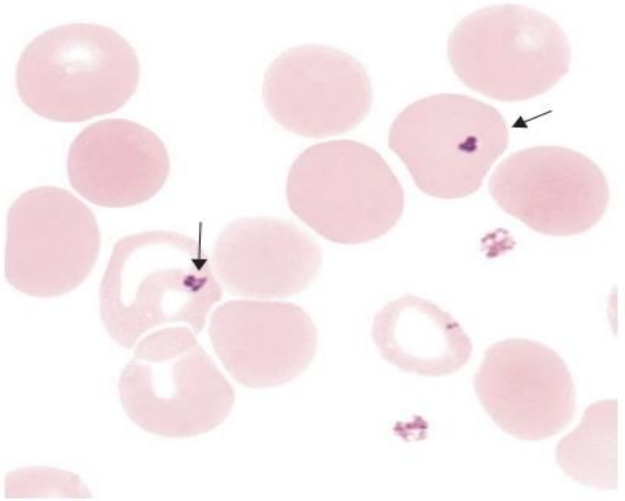
PAPPENHEIMER BODIES

Siderotic Granules



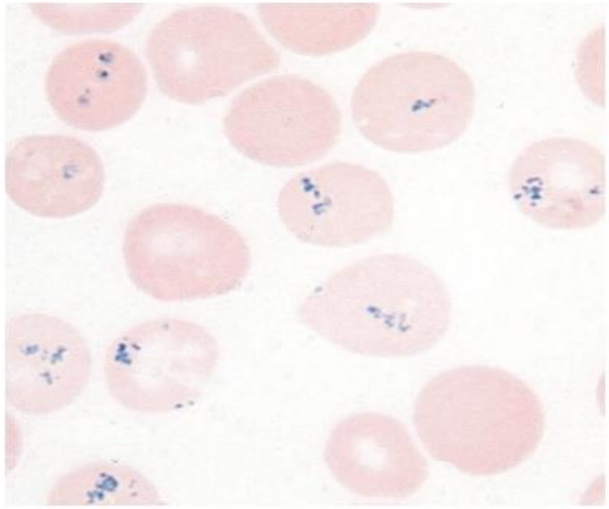
A

FIGURE 12–3A Pappenheimer bodies (Wright stain).



B

FIGURE 12–3B Pappenheimer bodies (Wright stain).

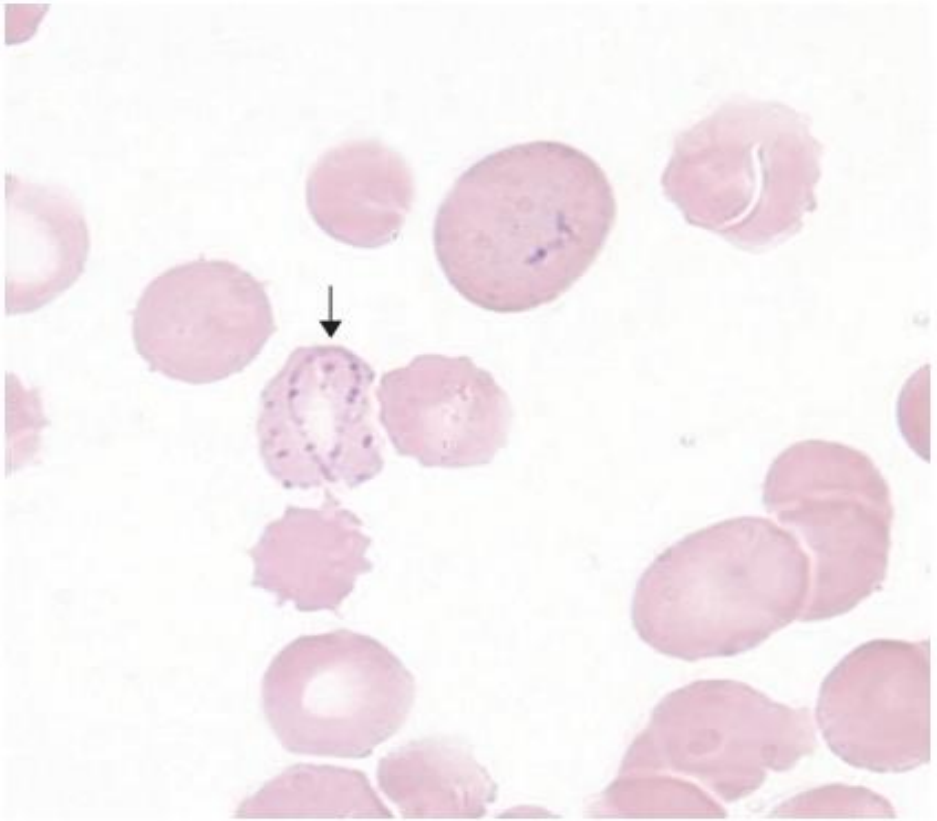


C

FIGURE 12–3C Siderotic granules (iron stain).

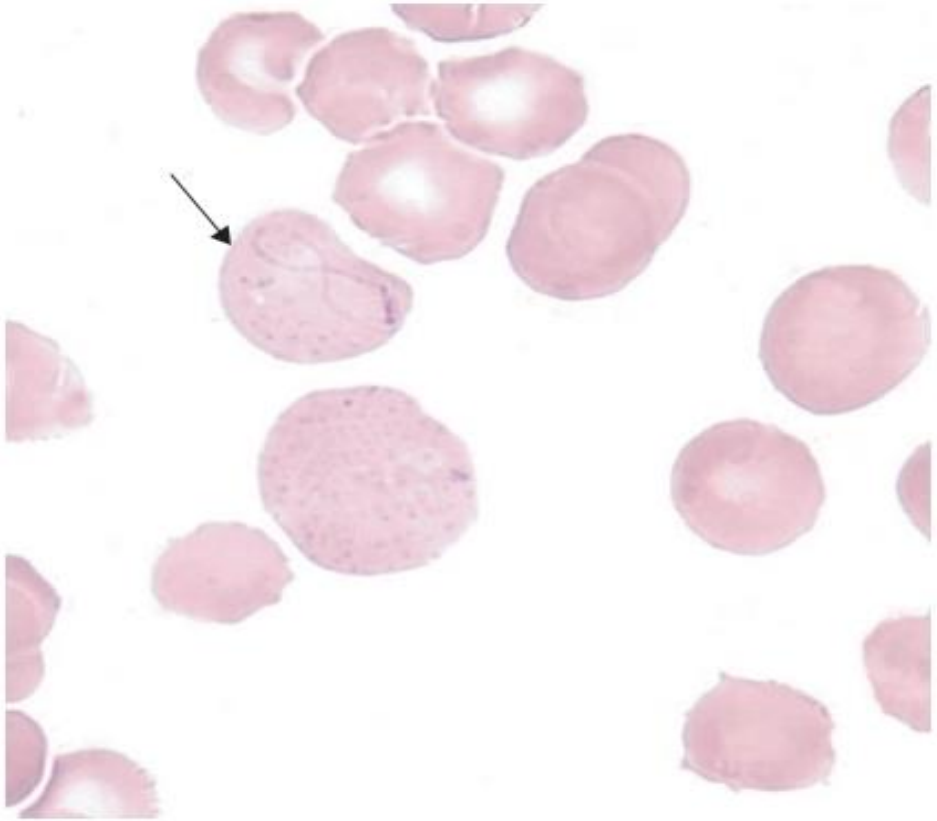
COLOR: Light blue
SHAPE: Fine irregular granules in clusters
NUMBER PER CELL: Usually one cluster; may be multiples; often at periphery of cell
COMPOSITION: Iron
Associated with: Splenectomy, hemolytic anemia, sideroblastic anemia, megaloblastic anemia, hemoglobinopathies

CABOT RINGS



A

FIGURE 12–4A Cabot ring.



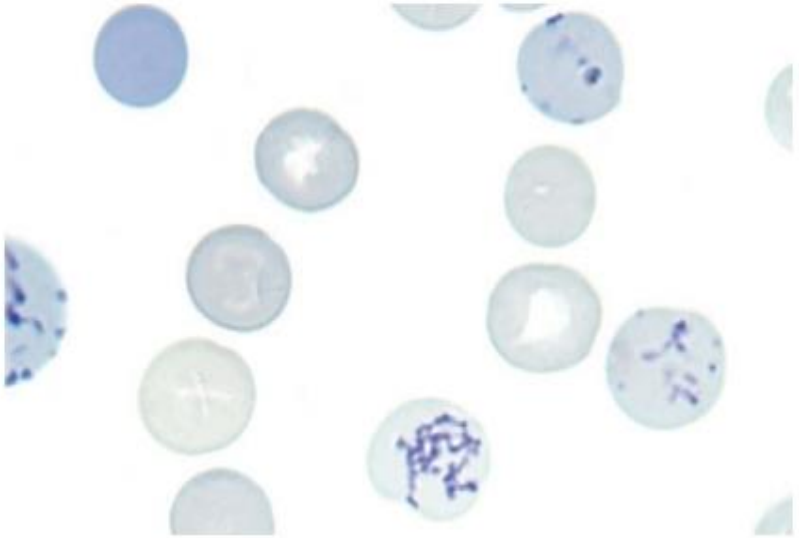
B

FIGURE 12–4B Cabot ring—figure eight.

COLOR: Dark blue to purple
SHAPE: Loop, ring, or figure eight; may look like beads on a string
NUMBER PER CELL: 1-2
COMPOSITION: Thought to be remnants of mitotic spindle
Associated with: Myelodysplastic syndrome, megaloblastic anemia
NOTE: This is a rare finding. Do not confuse with malaria (see Figure 21-1).

INCLUSIONS WITH SUPRAVITAL STAIN

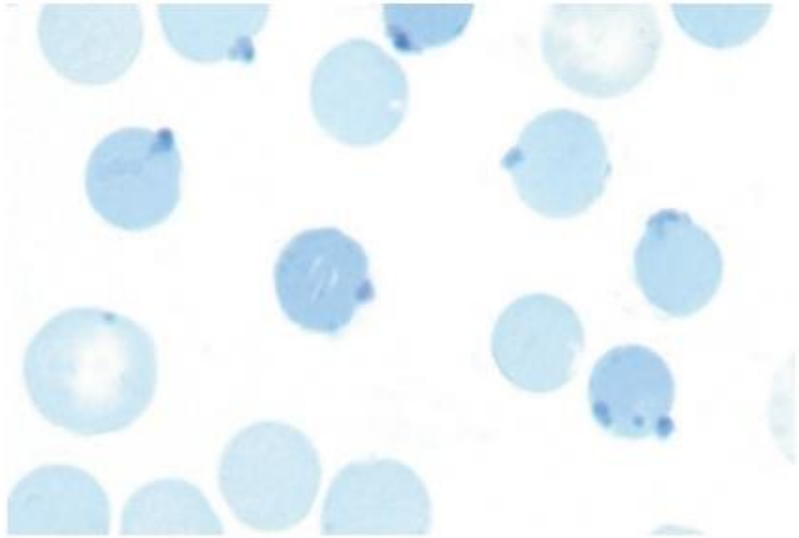
Stained with New Methylene Blue



A

FIGURE 12–5A Reticulocytes.

CELL: Anuclear immature erythrocyte
COMPOSITION: Precipitated RNA
NUMBER: ≥2 per cell
COLOR: Dark blue
Associated with: Erythrocyte maturation
NOTE: Supravital stains are taken up by living cells.



B

FIGURE 12–5B Heinz bodies.

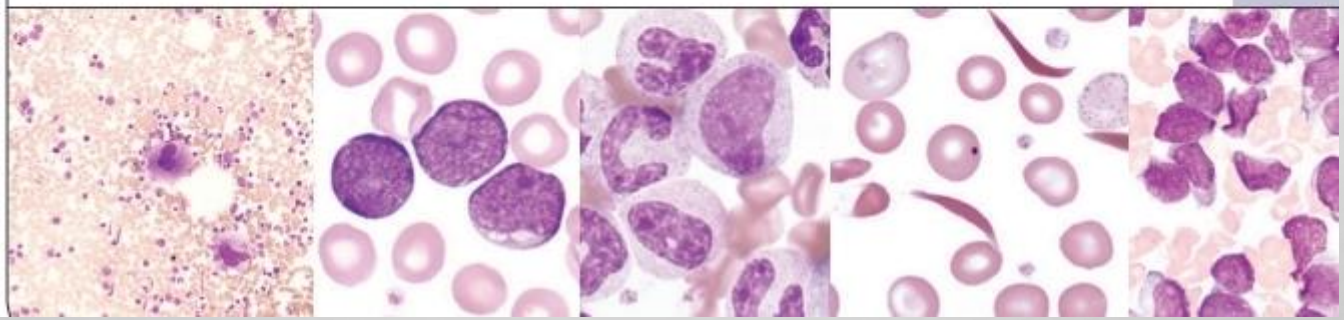
CELL: Mature erythrocyte
COMPOSITION: Precipitated hemoglobin
NUMBER: Single or multiple, generally membrane-bound
COLOR: Dark blue to purple
Associated with: Unstable hemoglobin, some hemoglobinopathies, some erythrocyte enzyme deficiencies (e.g., glucose-6-phosphate dehydrogenase)

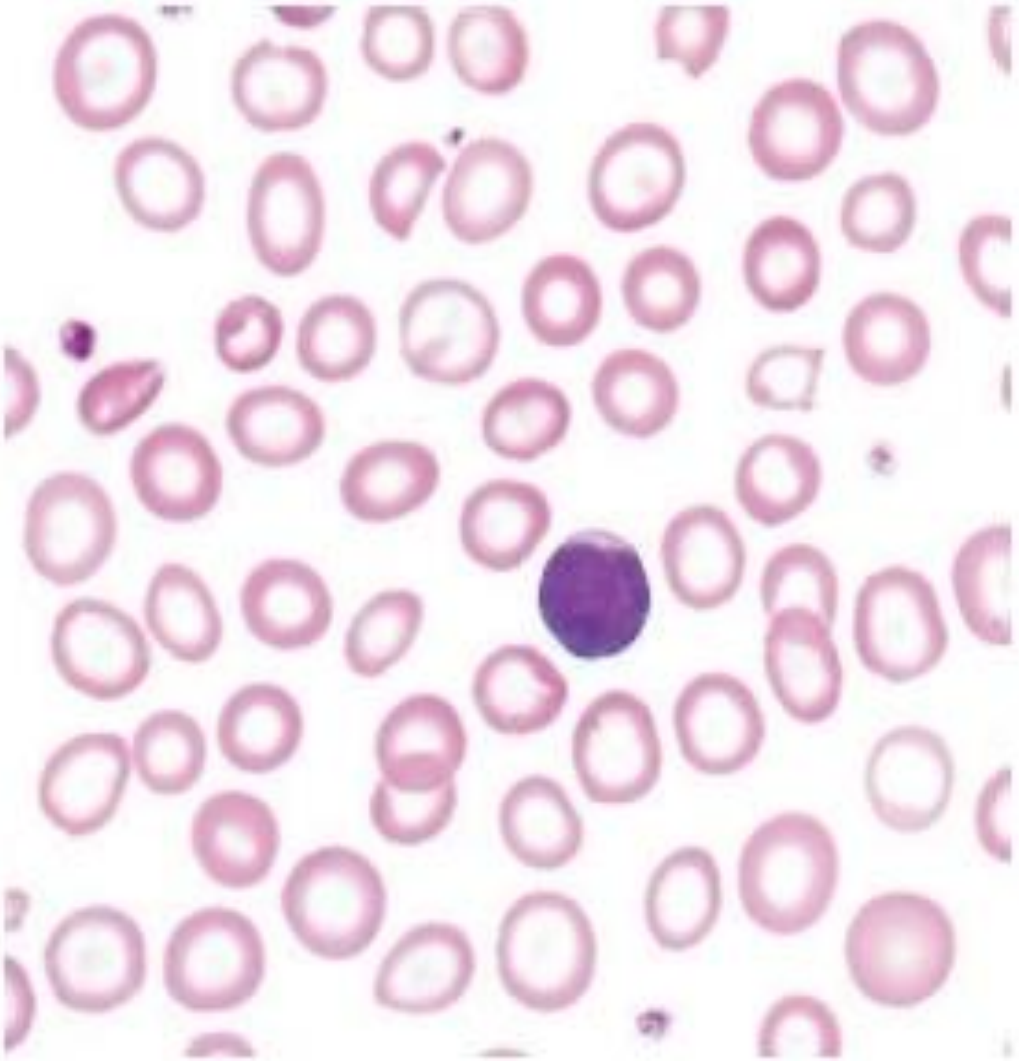
TABLE 12-1 Staining Qualities of Erythrocyte Inclusion Bodies

Inclusion	Composition	Wright- Giemsa Stain	New Methylene Blue (or Other Supravital Stain)	Prussian Blue (Iron)
Howell-Jolly body	DNA	+	+	0
Basophilic stippling	RNA	+	+	0
Pappenheimer body	Iron	+	+	+
Cabot ring	Remnant of mitotic spindle	+	+	0
Heinz body	Unstable hemoglobin	0	+	0
Hemoglobin H	β chains	0	+	0

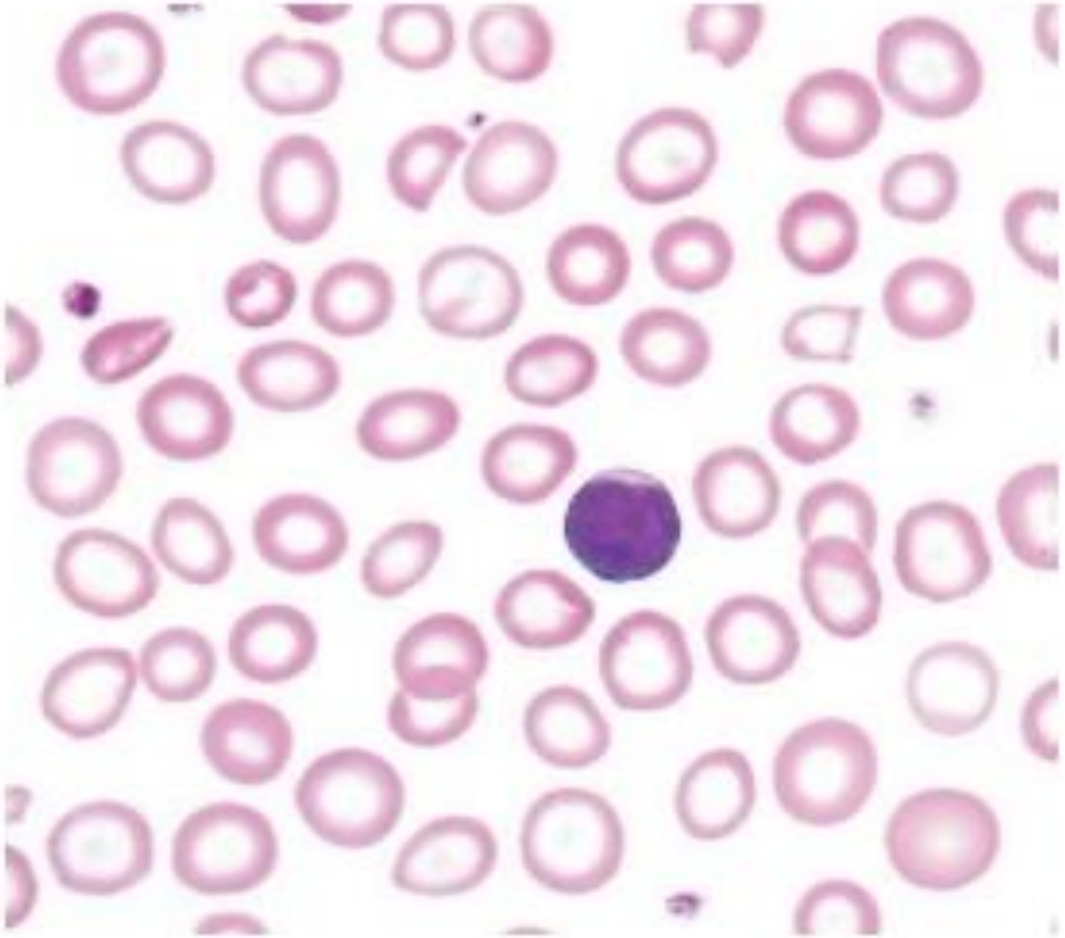
+, Positive; 0, negative.

DISEASES AFFECTING ERYTHROCYTES



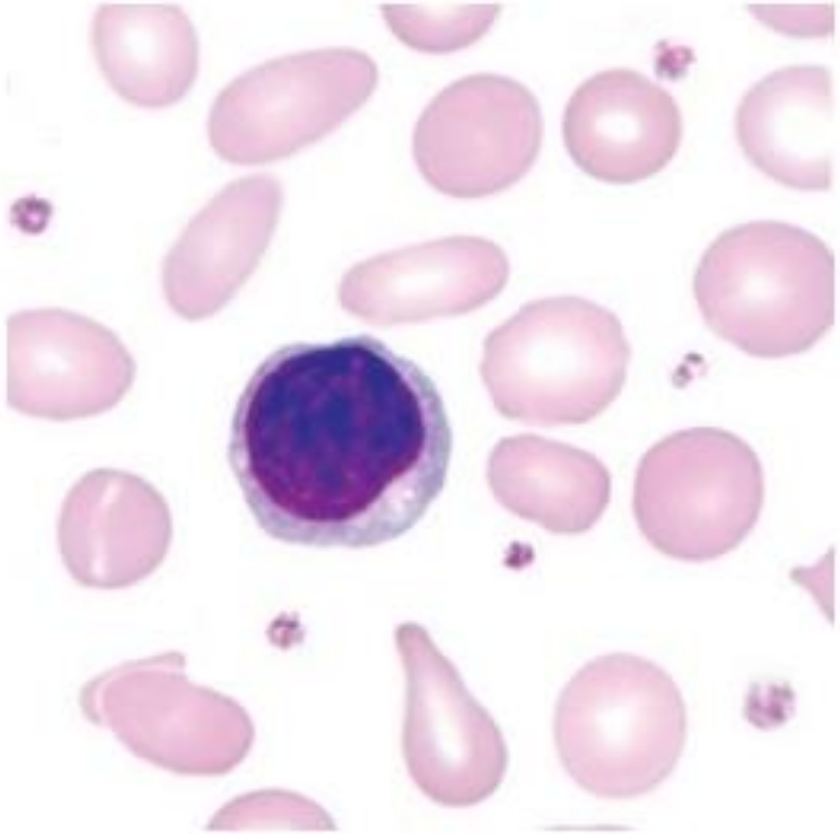


A



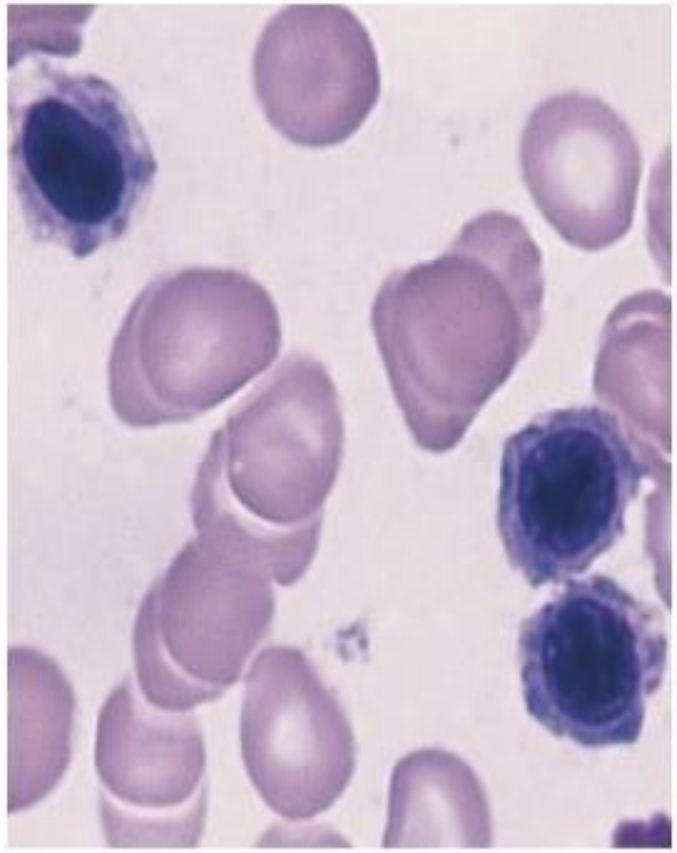
A

FIGURE 13–1A Severe iron deficiency anemia (peripheral blood [PB] ×500).



B

FIGURE 13–1B Iron deficiency anemia (PB ×1000).



C

FIGURE 13–1C Iron deficiency anemia (bone marrow [BM] ×1000; showing shaggy cytoplasm).

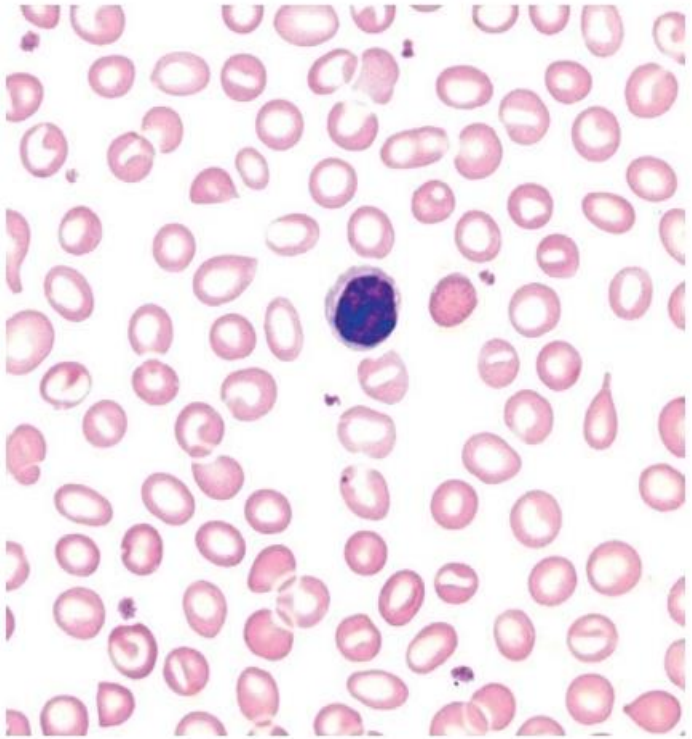
Peripheral Blood: Erythrocytes are hypochromic and microcytic; large variation in size; possible thrombocytosis

NOTE: Small lymphocyte depicted for size comparison.

Bone Marrow: Erythrocyte precursors are smaller and more numerous than normal and have shaggy cytoplasm. There is nuclear cytoplasmic asynchrony, with cytoplasmic maturation lagging behind that of the nucleus.

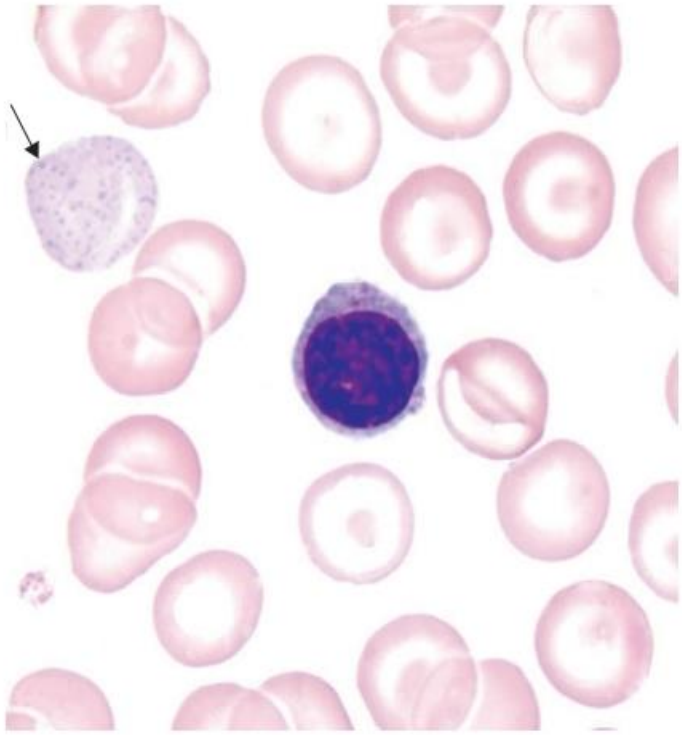
β-THALASSEMIA MINOR

β/β^{+} β/β^{o} $\beta/\delta\beta^{o}$ $\beta/\delta\beta^{Lepore}$



A

FIGURE 13–2A β-Thalassemia minor (PB ×500).



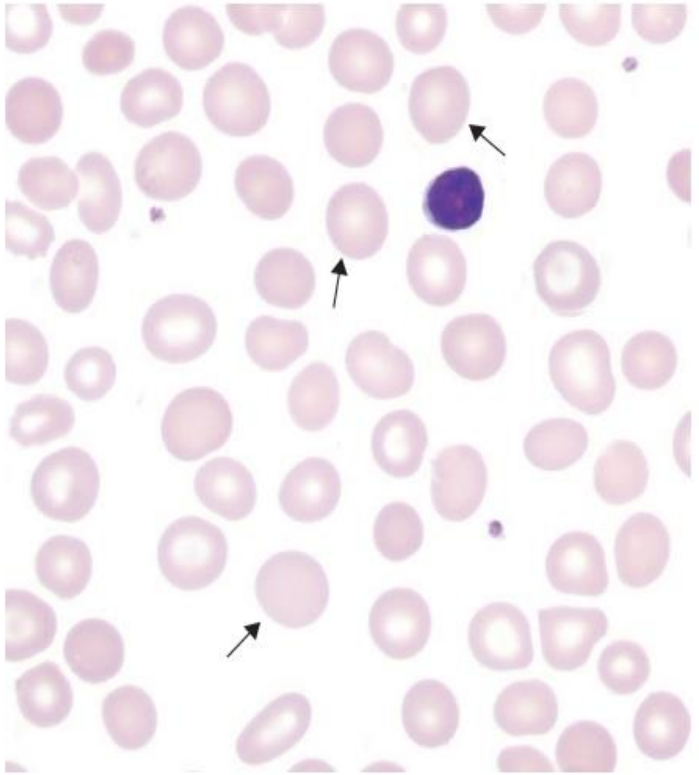
B

FIGURE 13–2B β-Thalassemia minor (PB ×1000). The presence of basophilic stippling (*arrow*) is common in thalassemia minor but not in iron deficiency anemia.

Peripheral Blood: Microcytosis, slight hypochromia, target cells, basophilic stippling

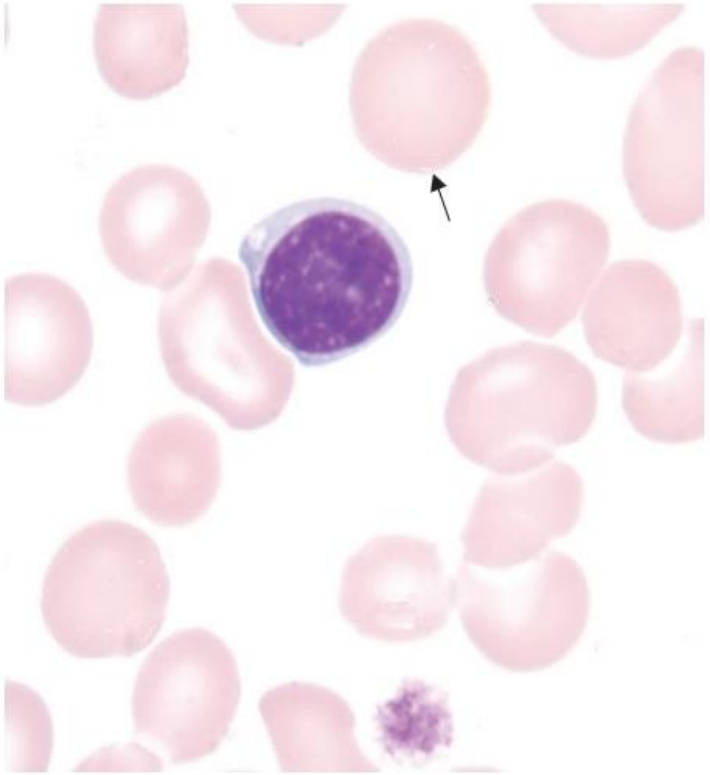
MACROCYTOSIS

Nonmegaloblastic



A

FIGURE 13–5A Macrocytic (nonmegaloblastic) (PB ×500).

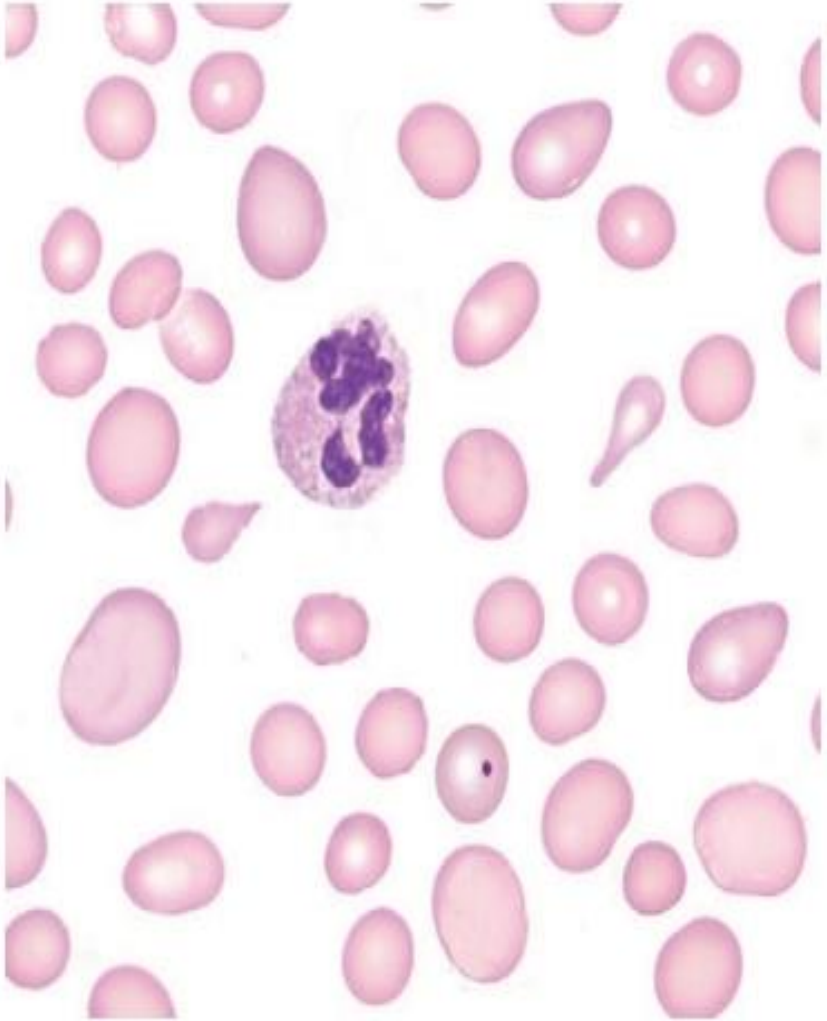


B

FIGURE 13–5B Macrocytic (nonmegaloblastic) (PB ×1000).

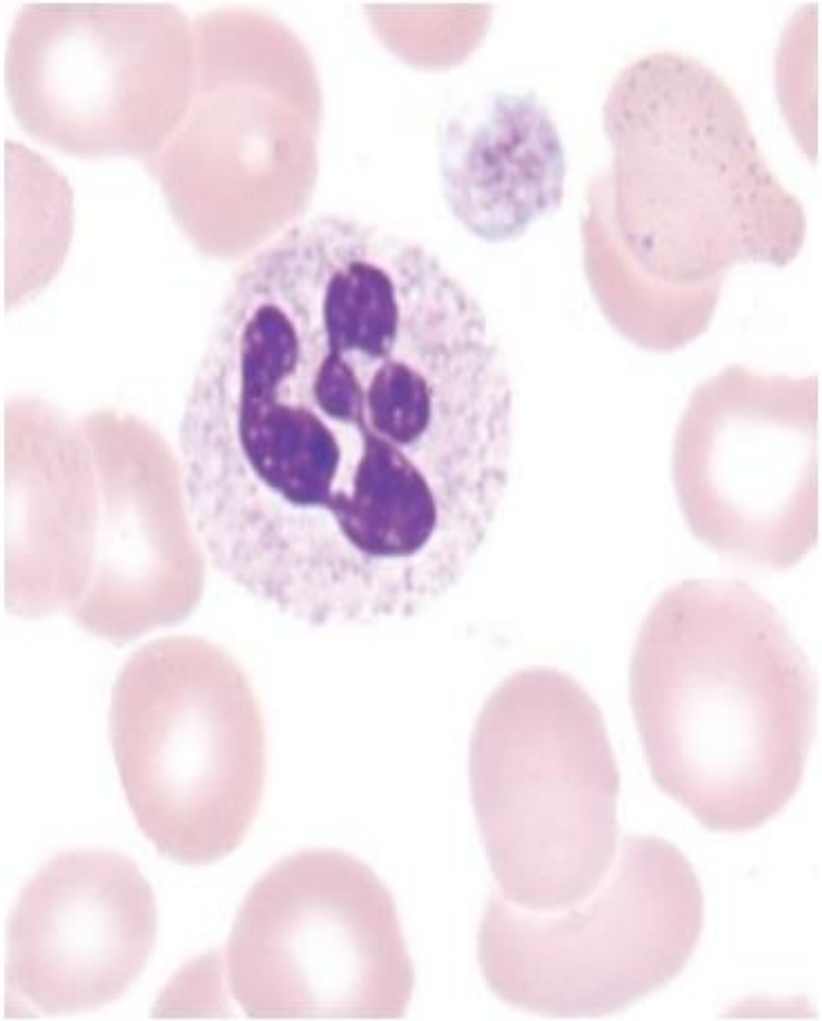
Peripheral Blood: Round macrocytes, leukocyte and platelet counts usually normal
Bone Marrow: No megaloblastic changes
Associated with: Normal newborn, liver disease, chronic alcoholism

MEGALOBLASTIC ANEMIA



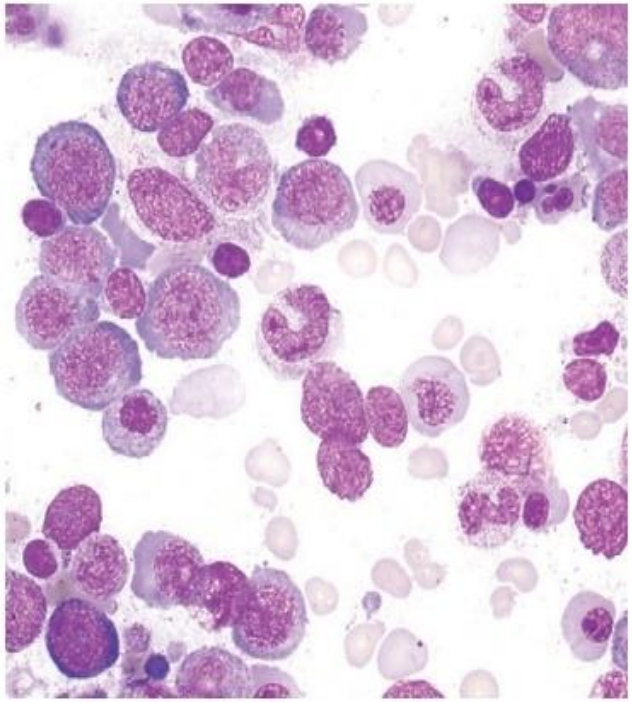
A

FIGURE 13-6A Megaloblastic anemia (PB ×500).



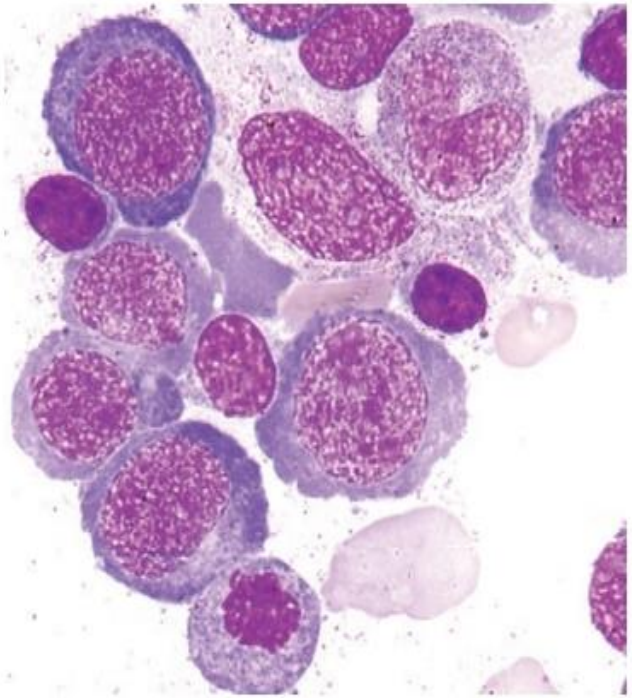
B

FIGURE 13-6B Megaloblastic anemia (PB ×1000).



C

FIGURE 13–6C Megaloblastic anemia (BM original ×500).



D

FIGURE 13–6D Megaloblastic anemia (BM original ×1000).

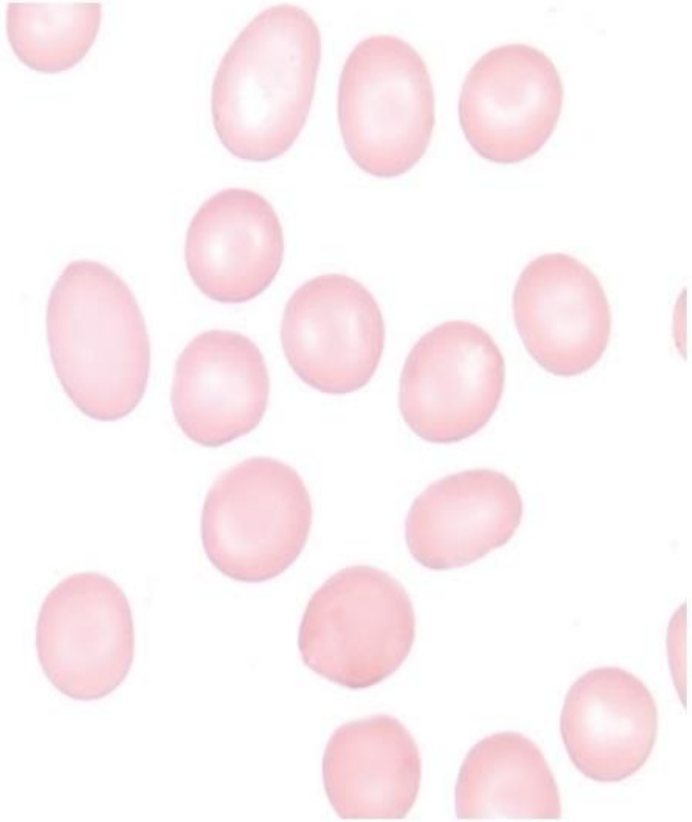
Peripheral Blood: Pancytopenia, hypersegmentation of neutrophils, oval macrocytes, Howell-Jolly bodies, nucleated erythrocytes, basophilic stippling, schistocytes, spherocytes, tear drop cells, target cells, giant platelets

NOTE: Characteristic triad of abnormalities: oval macrocytes, hypersegmented neutrophils, and Howell-Jolly bodies

Bone Marrow: Hypercellular, asynchrony (trilineage) with nuclear maturation lagging behind cytoplasmic maturation, giant bands, giant metamyelocytes, hypersegmented neutrophils

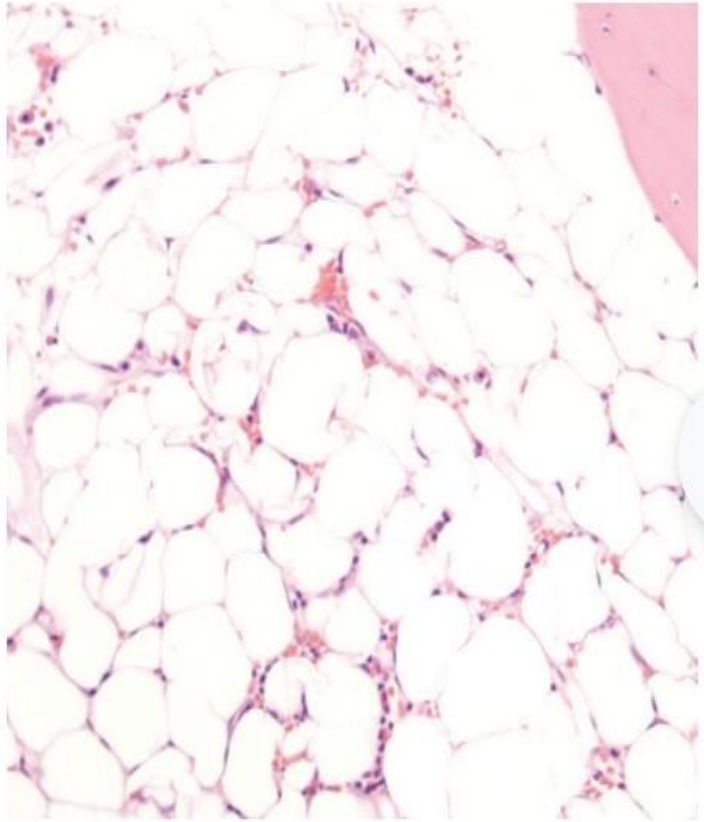
Associated with: Vitamin B_{12} deficiency, folate deficiency, myelodysplastic syndrome

APLASTIC ANEMIA



A

FIGURE 13–7A Aplastic anemia (PB ×1000).

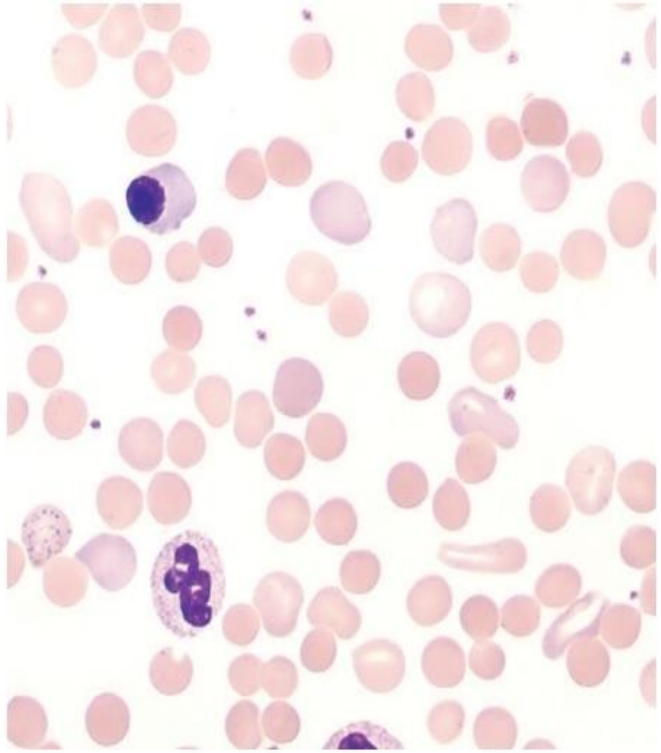


B

FIGURE 13–7B Aplastic anemia (BM biopsy ×1000).

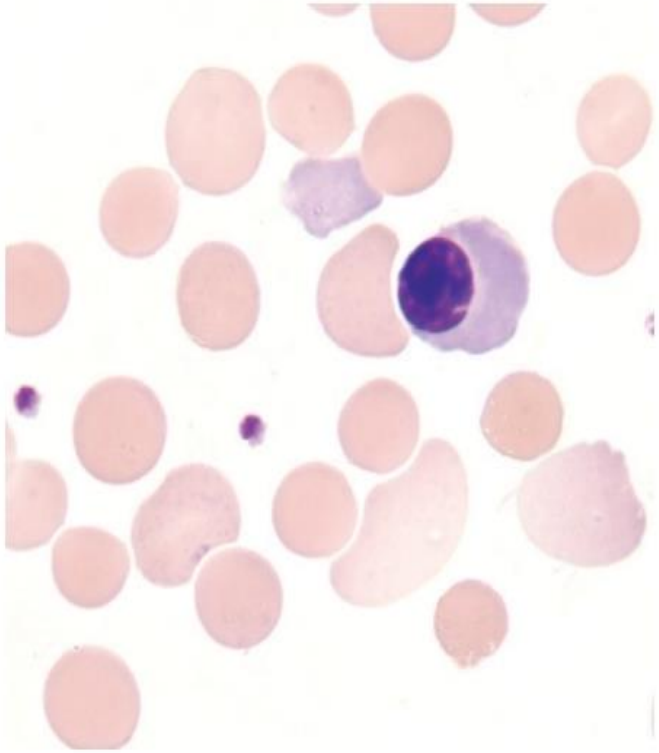
Peripheral Blood: Pancytopenia, normocytic, normochromic (occasional macrocytes)
Bone Marrow: Hypocellular; lymphocytes may predominate
Associated with: Bone marrow failure

IMMUNE HEMOLYTIC ANEMIA



A

FIGURE 13–8A Immune hemolytic anemia (PB ×500).

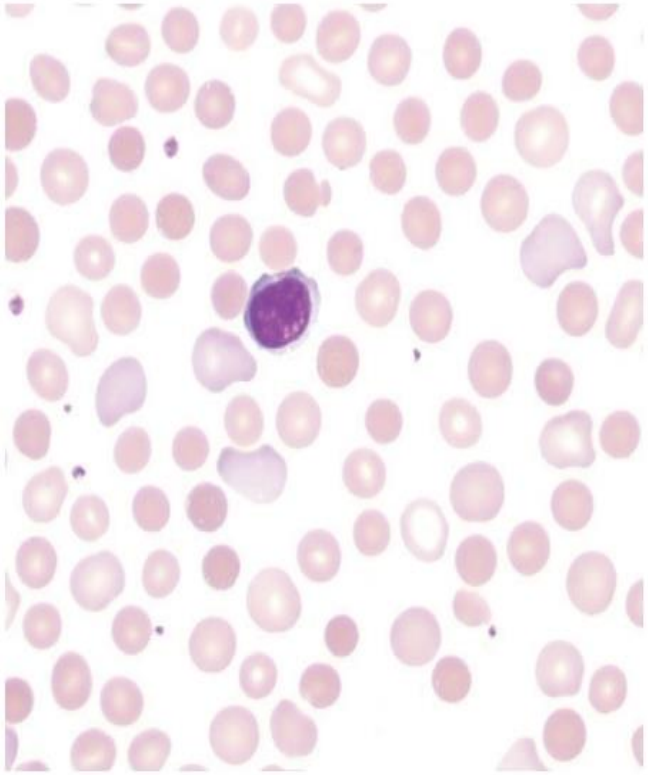


B

FIGURE 13–8B Immune hemolytic anemia (PB ×1000).

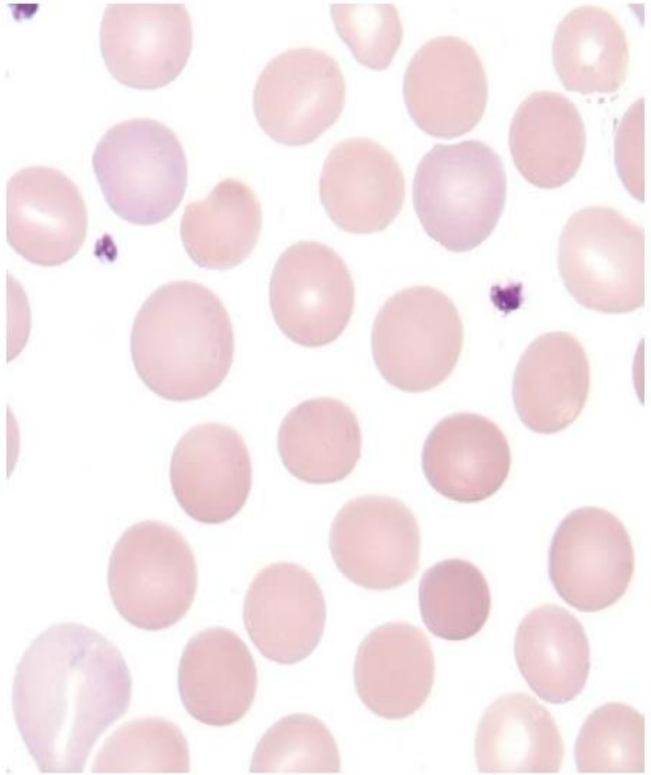
Peripheral Blood: Spherocytes, schistocytes, polychromasia, nucleated erythrocytes
Associated with: Autoimmune, alloimmune (see also hemolytic disease of the fetus and newborn, Figure 13-9), drug-induced hemolytic anemia
NOTE: Erythrocyte morphology varies with cause and severity of disease.

HEREDITARY SPHEROCYTOSIS



A

FIGURE 13–10A Hereditary spherocytosis (PB ×500).



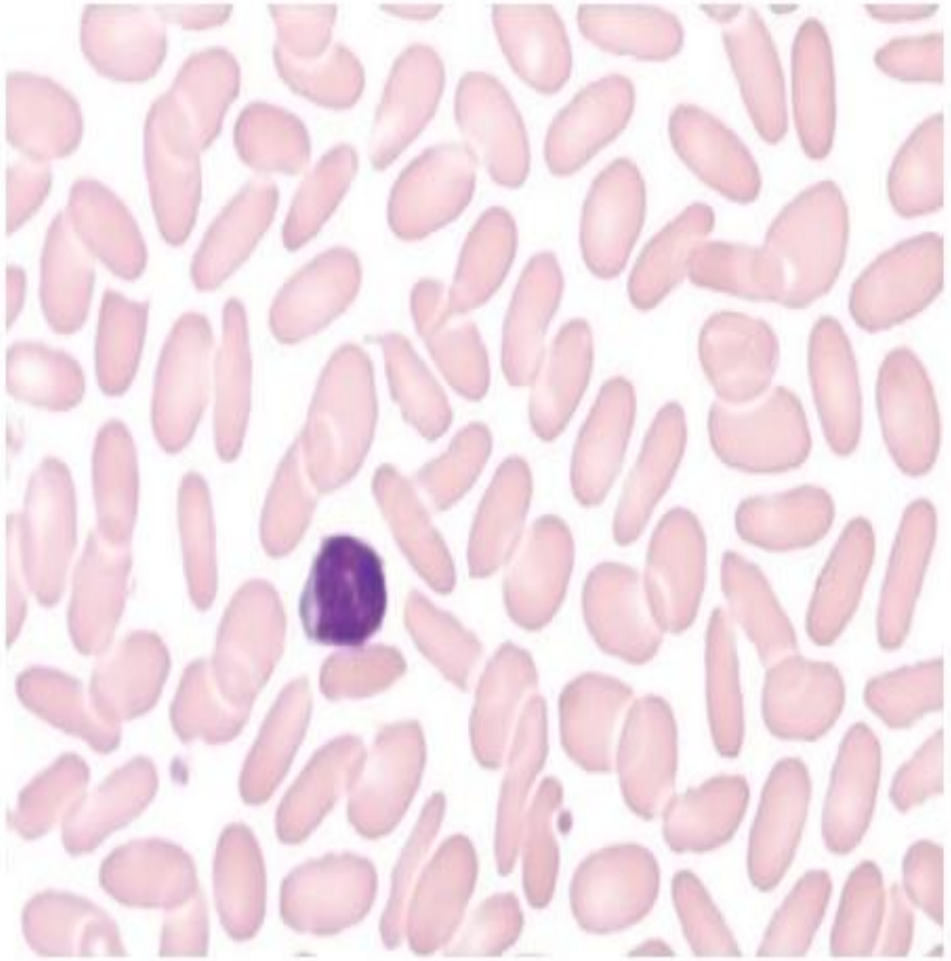
B

FIGURE 13–10B Hereditary spherocytosis (PB ×1000).

Peripheral Blood: Spherocytes (variable in number), polychromasia; nucleated erythrocytes possible

Associated with: Red cell membrane defects

HEREDITARY ELLIPTOCYTOSIS



A

FIGURE 13–11A Hereditary elliptocytosis (PB ×500)

Peripheral Blood: >25% elliptocytes, usually >60% elliptocytes; indices are normocytic, normochromic

Associated with: Red cell membrane defects

VARIANTS OF ELLIPTOCYTOSIS

Hemolytic

Peripheral Blood: Microelliptocytes, schistocytes, spherocytes

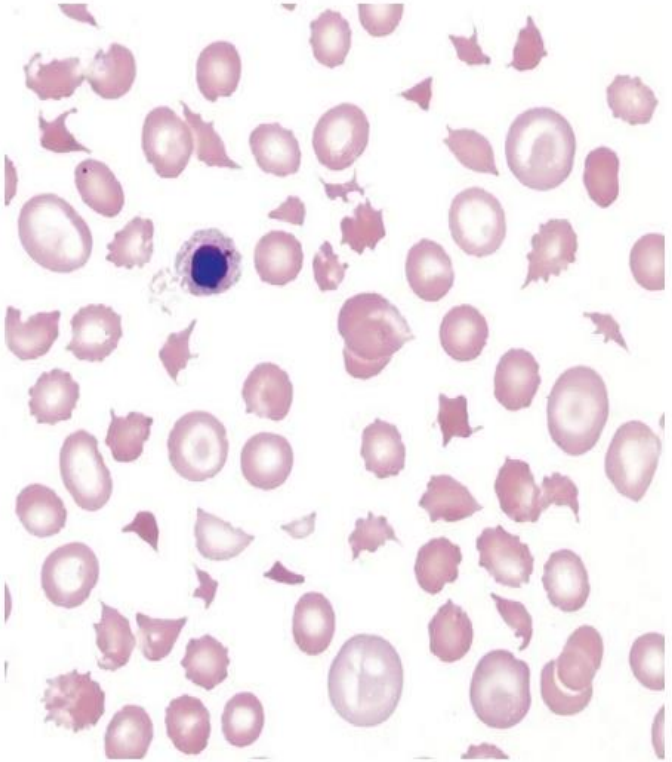
Associated with: Red cell membrane defects

Pyropoikilocytosis

Peripheral Blood: Elliptocytes, schistocytes, microspherocytes (see Figure 11-4, *B*).

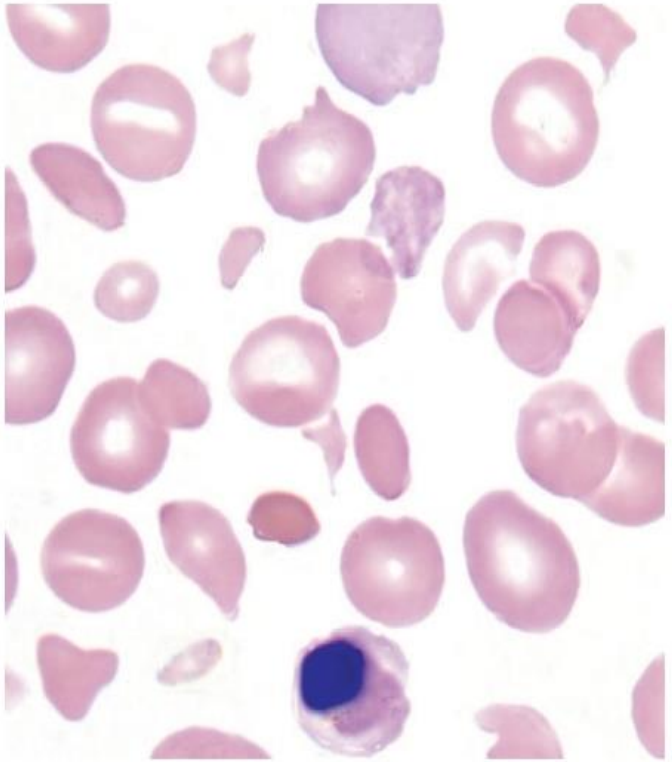
Associated with: Red cell membrane defects

MICROANGIOPATHIC HEMOLYTIC ANEMIA



A

FIGURE 13–12A Microangiopathic hemolytic anemia (PB ×500).



B

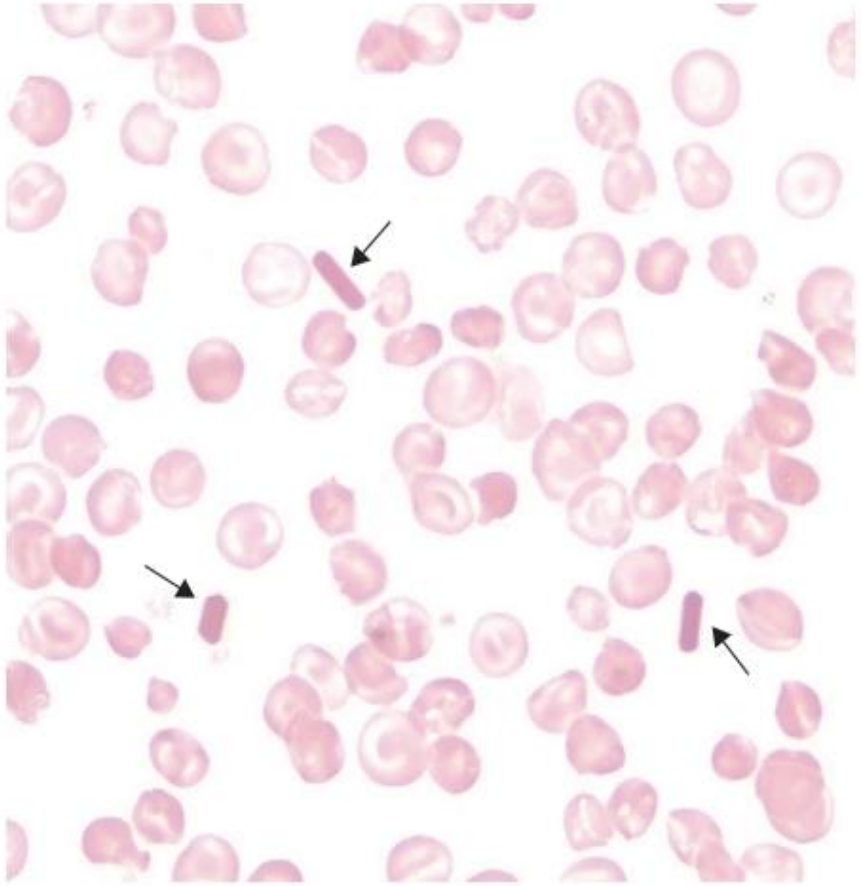
FIGURE 13–12B Microangiopathic hemolytic anemia (PB ×1000).

Peripheral Blood: Schistocytes, spherocytes, polychromasia, nucleated erythrocytes, decreased platelet count

Associated with: Thrombotic thrombocytopenic purpura, hemolytic uremic syndrome, HELLP syndrome (Hemolytic anemia, Elevated Liver enzymes and Low Platelet count), disseminated intravascular coagulation, hypertensive crises

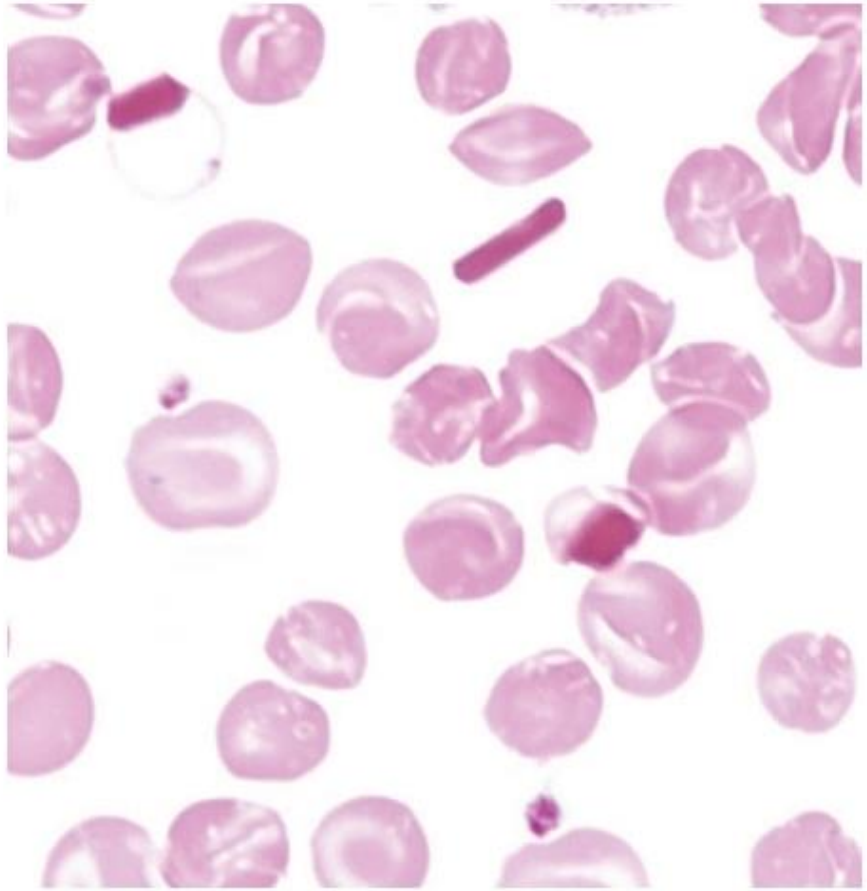
NOTE: The degree of morphological change correlates directly with severity of the disease.

HEMOGLOBIN CC DISEASE



A

FIGURE 13–13A Hemoglobin CC (PB ×500).



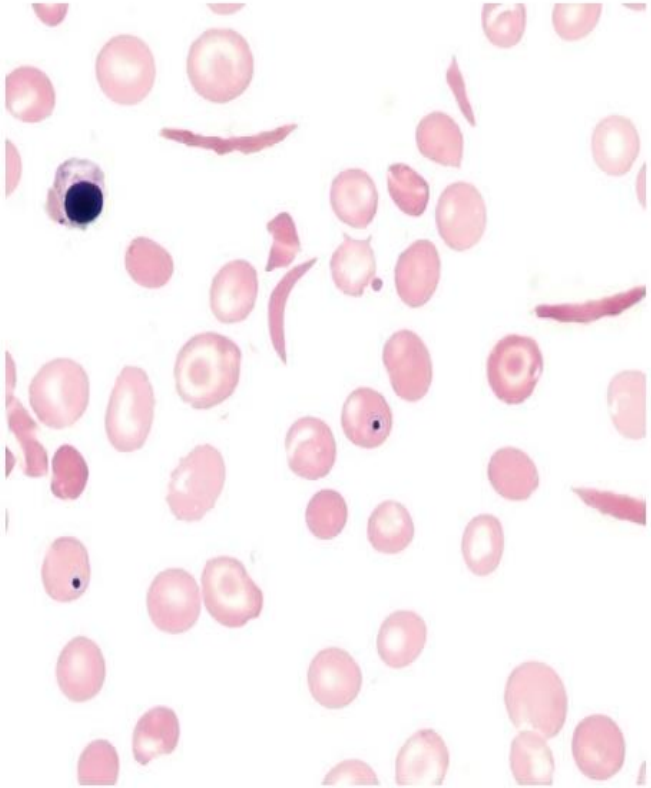
B

FIGURE 13–13B Hemoglobin CC (PB ×1000).

Peripheral Blood: Polychromasia, target cells, spherocytes, microcytes, intracellular and/or extracellular rod-shaped crystals possible

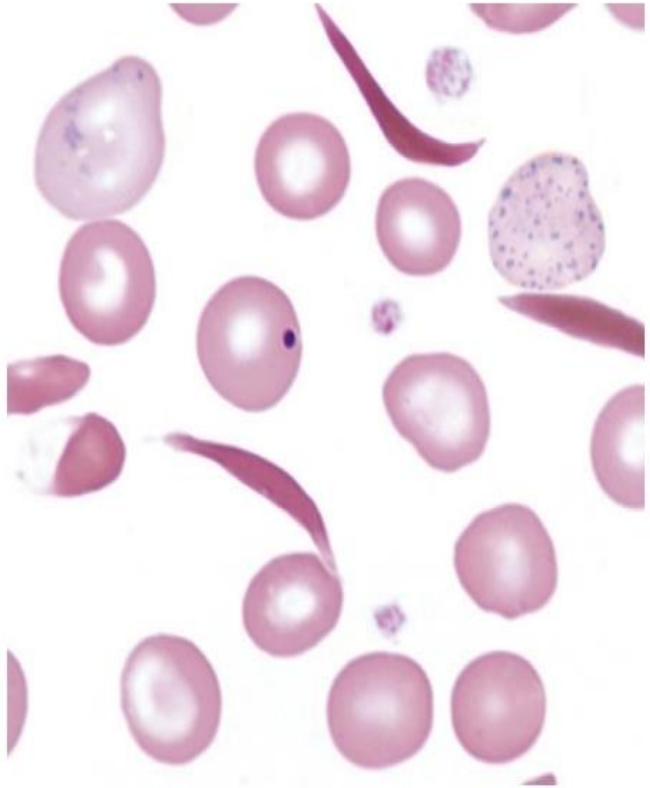
Associated with: Homozygous hemoglobin C (see Figure 11-7)

HEMOGLOBIN SS DISEASE



A

FIGURE 13–14A Hemoglobin SS (PB ×500).



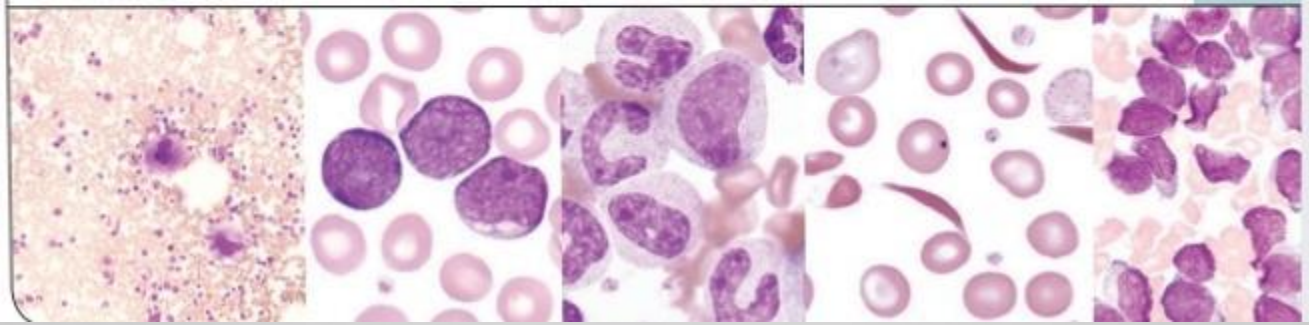
B

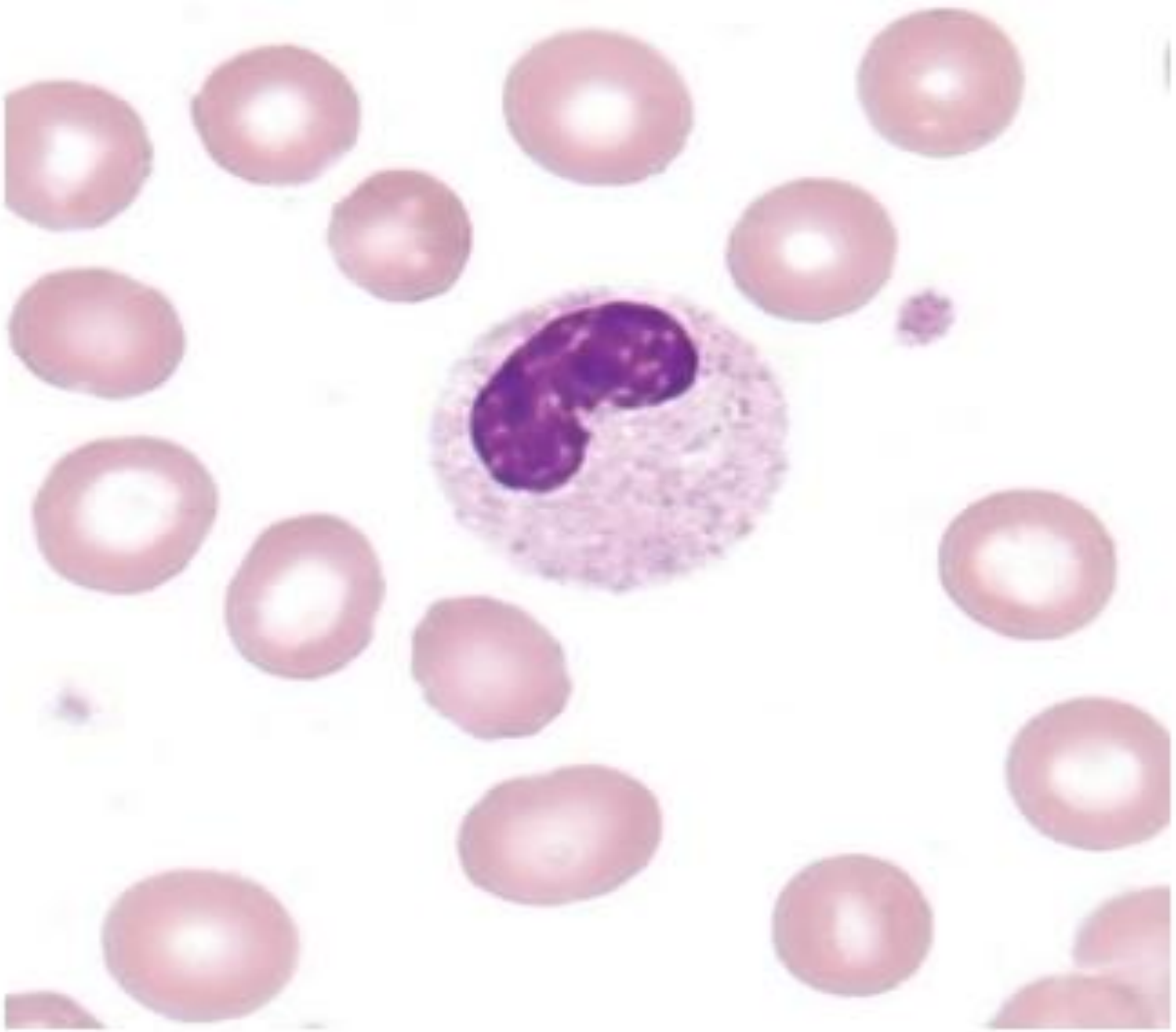
FIGURE 13–14B Hemoglobin SS (PB ×1000).

Peripheral Blood: Sickle cells (in crises), target cells, nucleated erythrocytes, schistocytes, Howell-Jolly bodies, basophilic stippling, Pappenheimer bodies, polychromasia, increased leukocyte count with neutrophilia, thrombocytosis

Associated with: Homozygous hemoglobin S (see Figure 11-6)

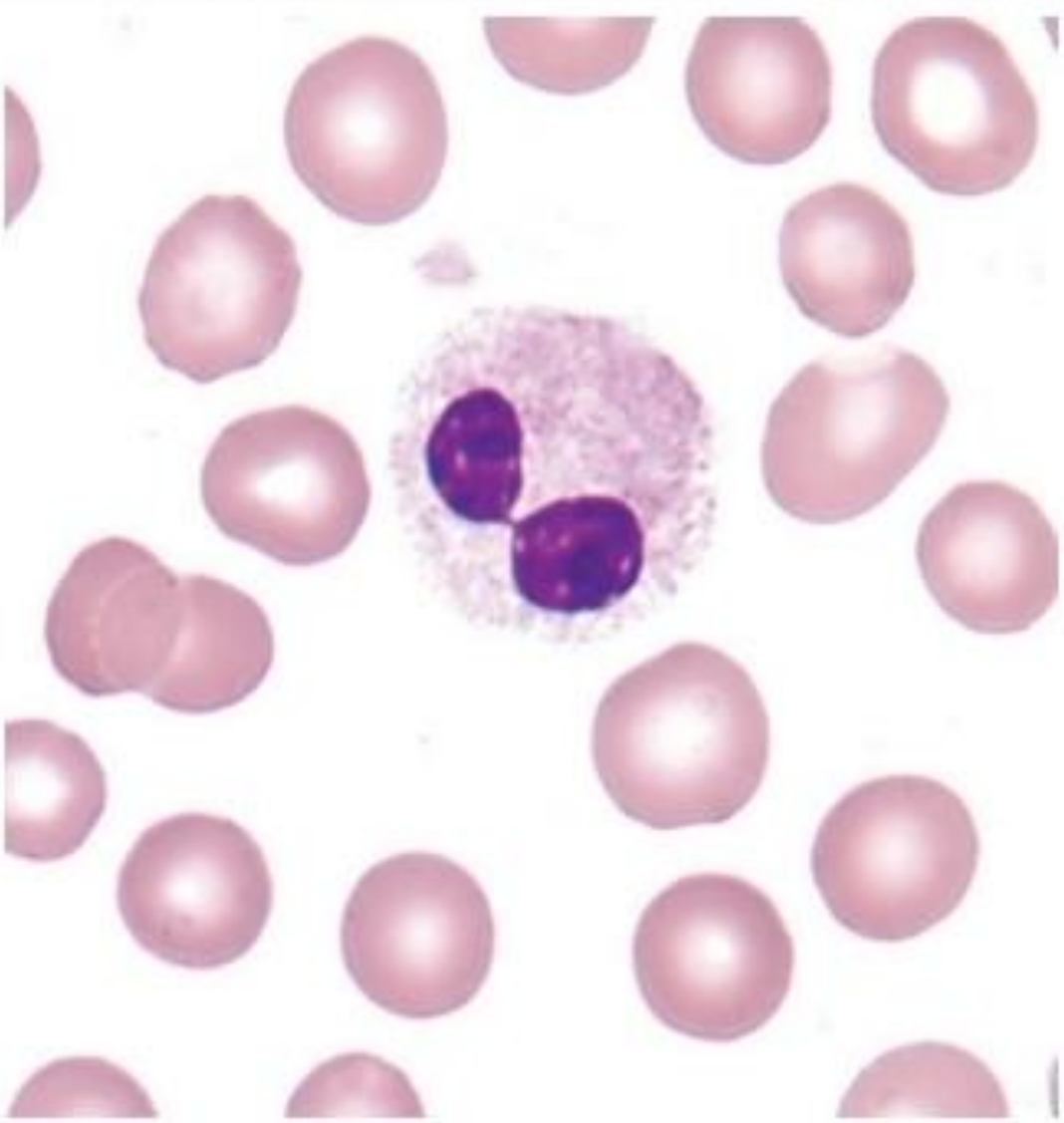
NUCLEAR AND CYTOPLASMIC CHANGES IN LEUKOCYTES





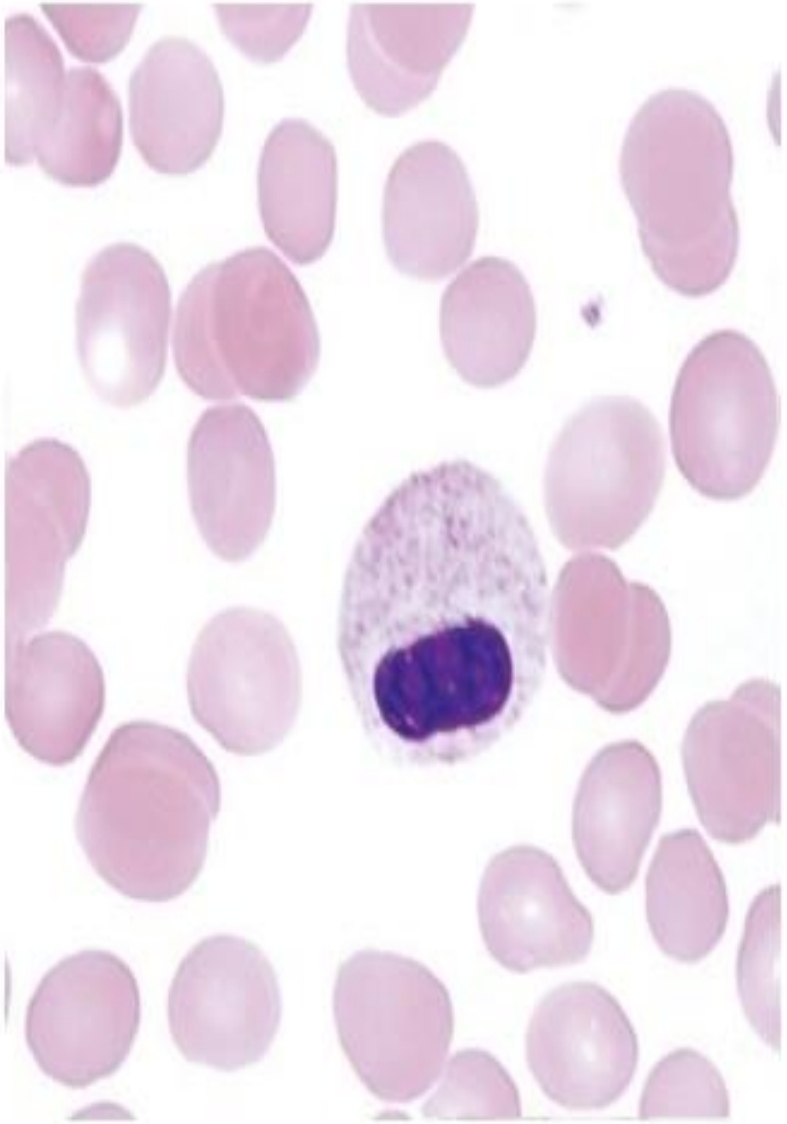
A

FIGURE 14–1A Hyposegmentation—peanut-shaped nucleus (PB ×1000).



B

FIGURE 14–1B Hyposegmentation—bilobed nucleus (PB ×1000).



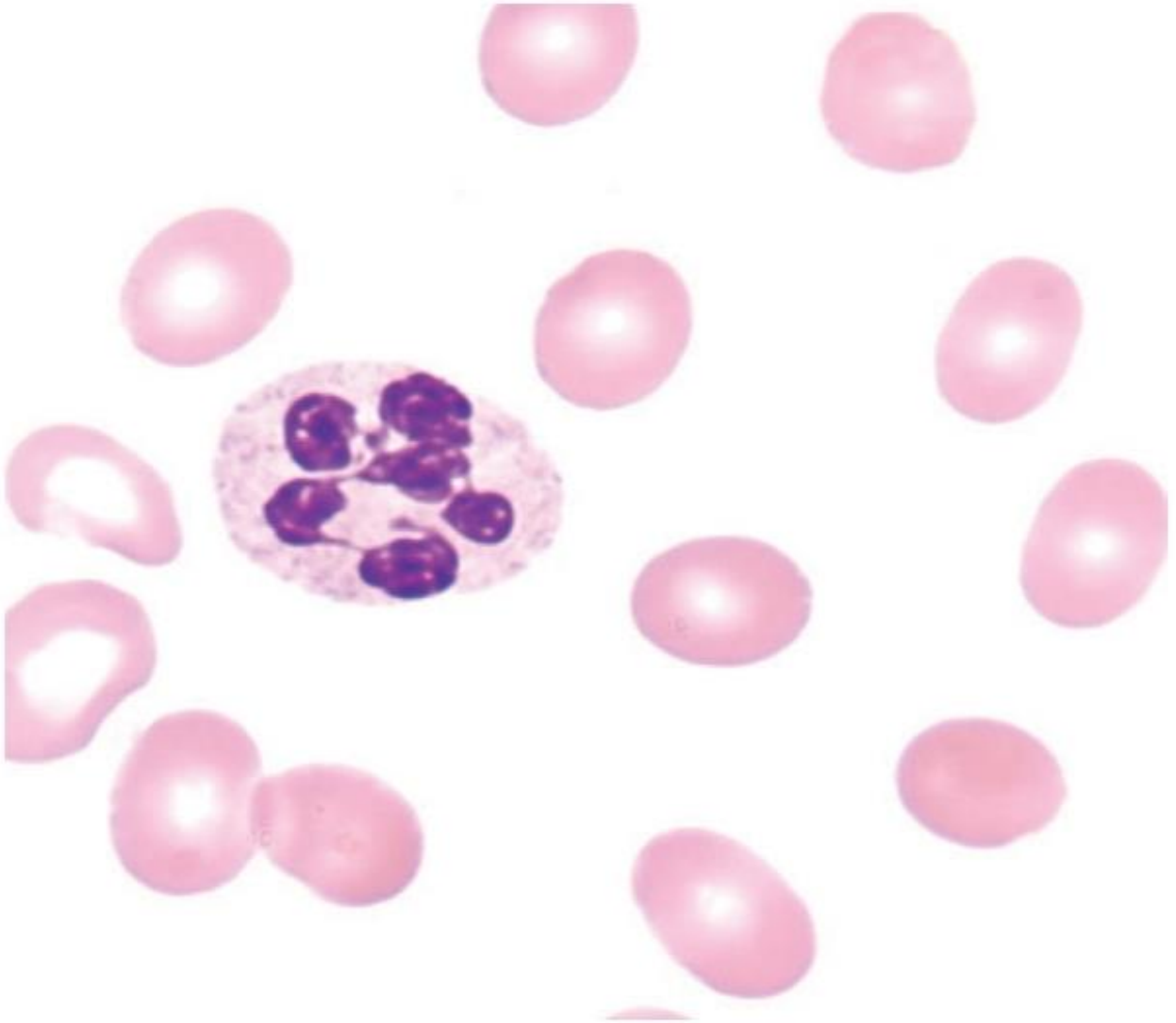
C

FIGURE 14–1C Non-segmented nucleus (PB ×1000)

DESCRIPTION: Peanut-shaped, bilobed or non-segmented, granulocyte nucleus with the coarse chromatin of a mature cell.

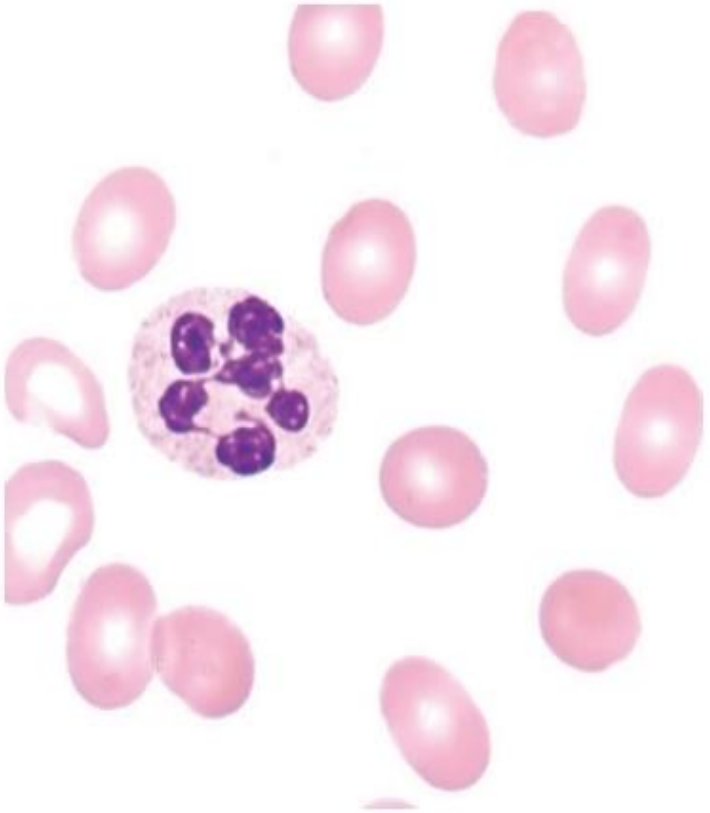
Associated with: Pelger-Hüet anomaly, pseudo-Pelger-Hüet anomaly

NOTE: Pelger-Hüet anomaly is inherited and affects the majority of granulocytes. Pseudo-Pelger–Hüet is acquired, affects less than 50% of granulocytes and is usually accompanied by other morphologic indications of malignancy such as seen in myeloproliferative or myelodysplastic disorders (see Chapters 17 and 18).



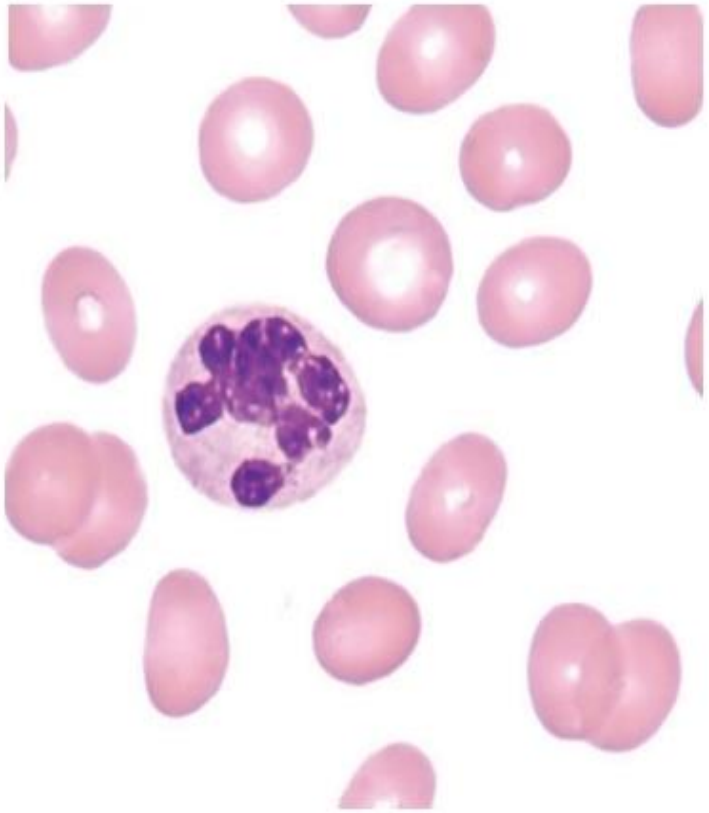
A

FIGURE 14–2A Hypersegmented neutrophil (PB ×1000).



A

FIGURE 14–2A Hypersegmented neutrophil (PB ×1000).



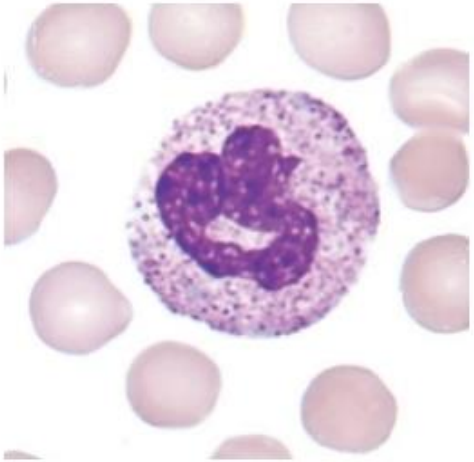
B

FIGURE 14–2B Hypersegmented neutrophil (PB ×1000).

DESCRIPTION: Six or more lobes in granulocyte nucleus

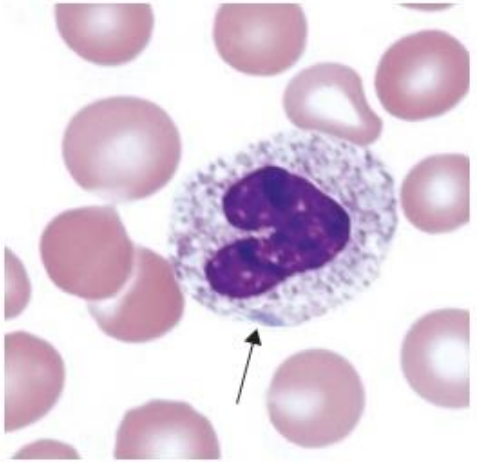
Associated with: Megaloblastic anemias; chronic infections; myelodysplastic syndrome; rarely inherited

TOXIC GRANULATION



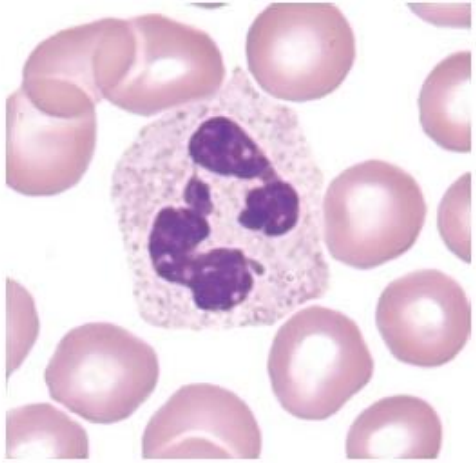
A

FIGURE 14–5A Toxic granulation.



B

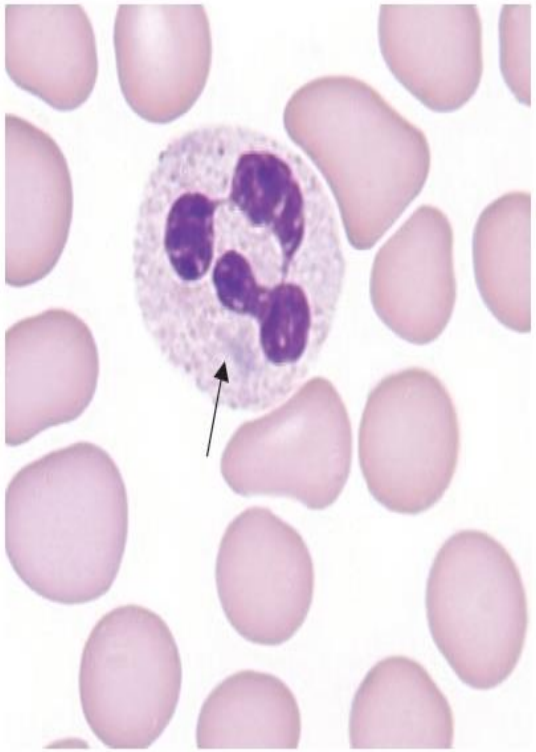
FIGURE 14–5B Toxic granulation and Döhle body (*arrow*). Cytoplasm may retain blue color due to cell's early release from bone marrow.



C

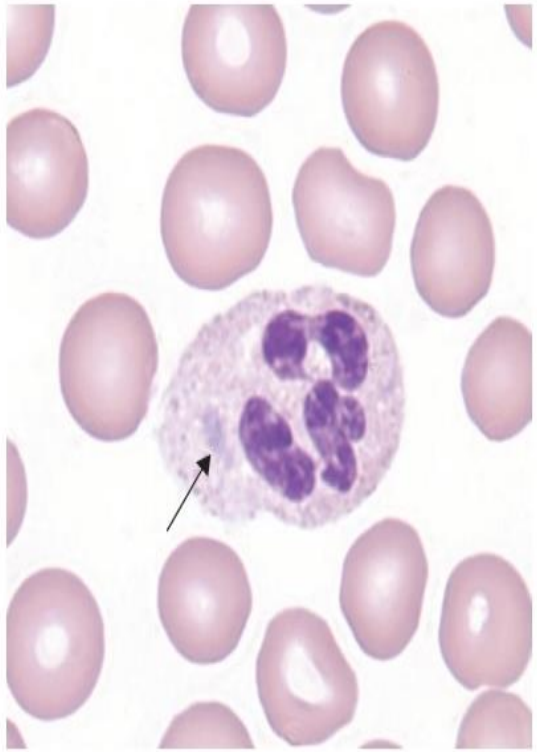
FIGURE 14–5C Normal segmented neutrophil for comparison.

DESCRIPTION: Prominent dark purple-black granules
LOCATION: Cytoplasm of neutrophils, unevenly distributed
COMPOSITION: Primary granules
NUMBER: Few to many
Associated with: Wide range of conditions including bacterial infection, sepsis and following administration of granulocyte colony-stimulating factor.



A

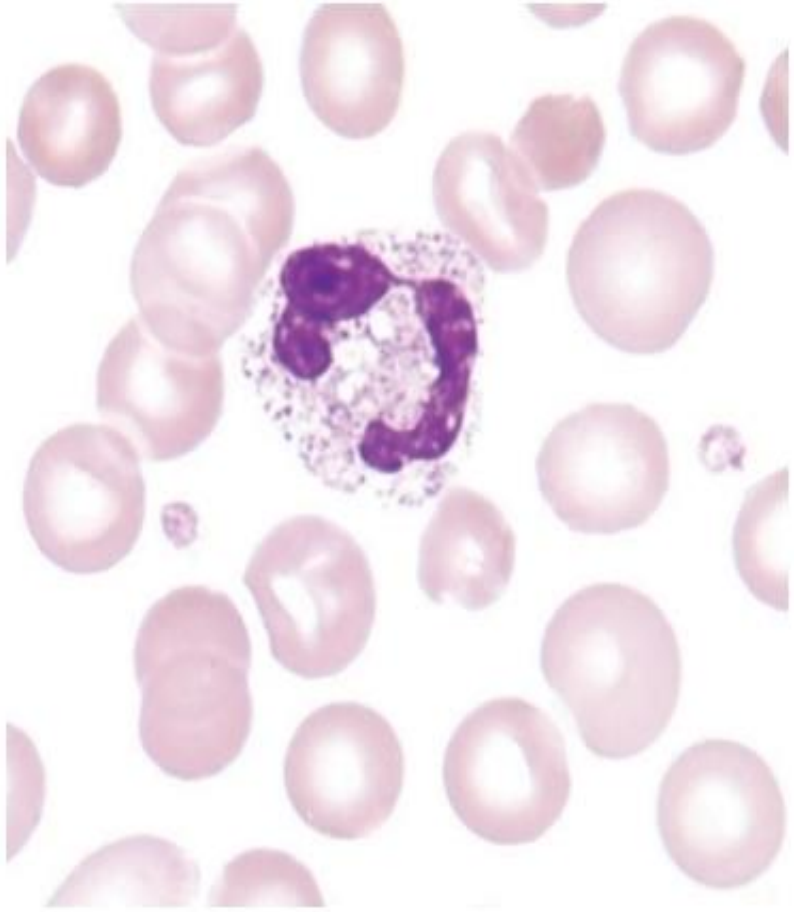
FIGURE 14-4A Döhle body.



B

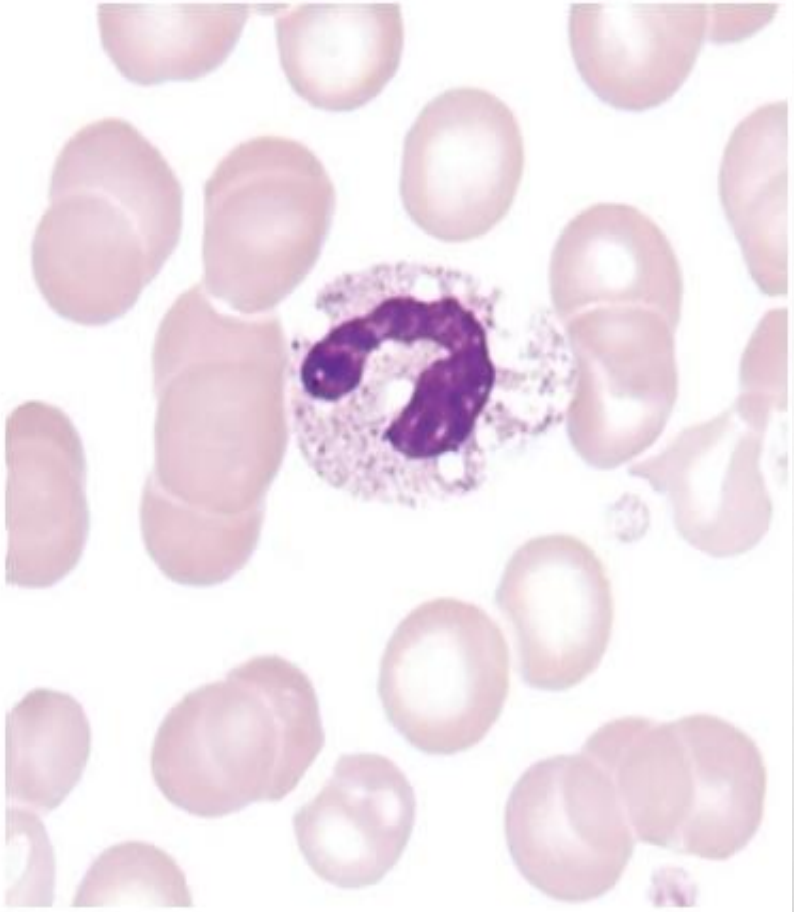
FIGURE 14-4B Döhle body

DESCRIPTION: Gray-blue, variably shaped
LOCATION: Cytoplasm
COMPOSITION: Ribosomal RNA
NUMBER: Single or multiple
Associated with: Wide range of conditions, including bacterial infection, sepsis and normal pregnancy
NOTE: May be seen in cells with toxic granulation or on same slide with toxic granulation. (see Figure 14-5, *B*)



A

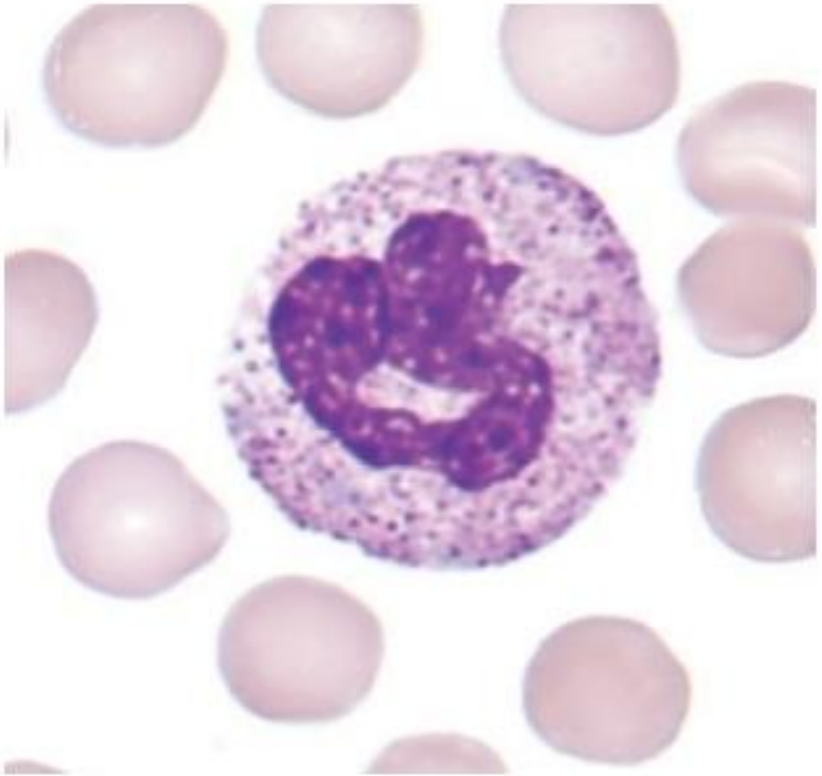
FIGURE 14–3A Vacuoles.



B

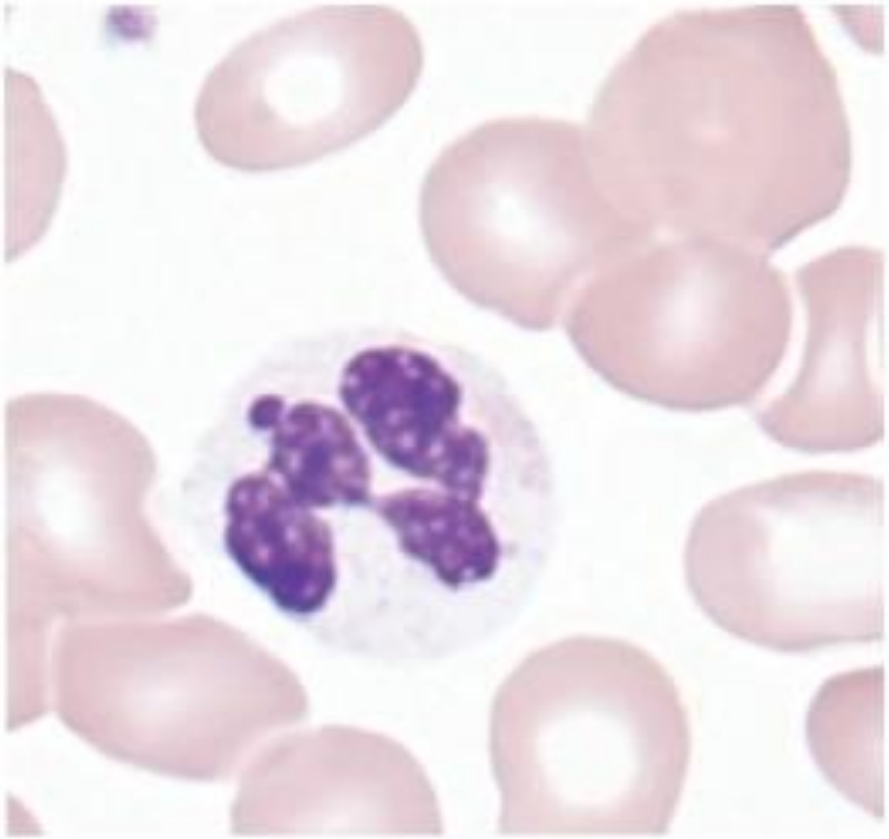
FIGURE 14–3B Vacuoles.

DESCRIPTION: Unstained circular area within the cytoplasm.
NUMBER: Few to many
Associated with: Bacterial or fungal infection, poisoning, burns, chemotherapy, artifact
NOTE: Rarely may contain micro-organisms or pigment.



A

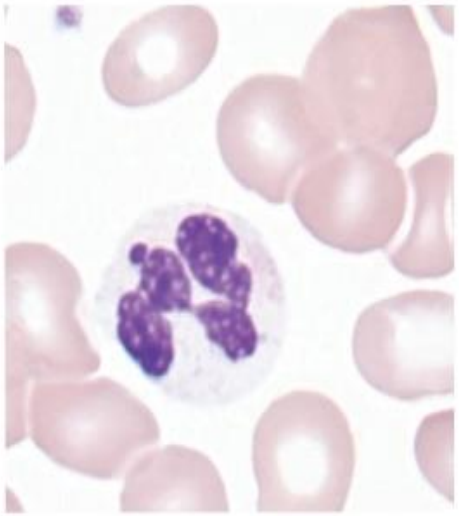
FIGURE 14–5A Toxic granulation.



A

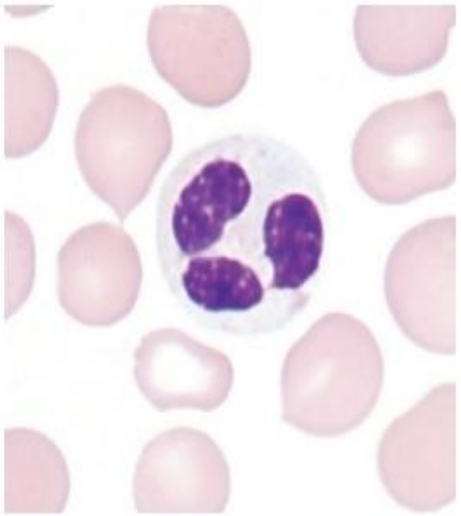
FIGURE 14–6A Hypogranulation.

HYPOGRANULATION/AGRANULATION



A

FIGURE 14-6A Hypogranulation.

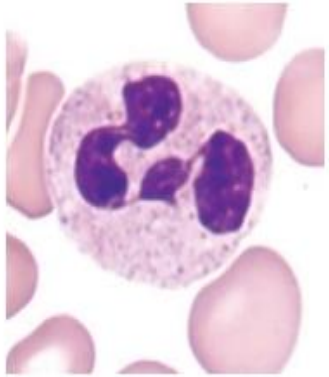


B

FIGURE 14-6B Agranulation.

DESCRIPTION: Decreased number or absence of specific granules giving the cytoplasm a colorless appearance

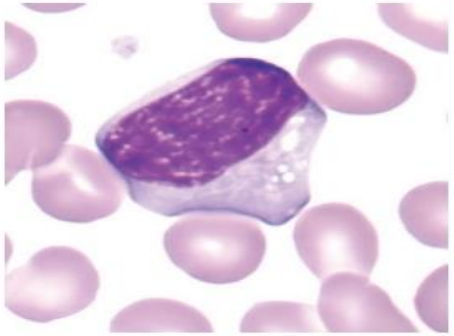
Associated with: Myelodysplastic syndrome, myeloproliferative neoplasms, infection



C

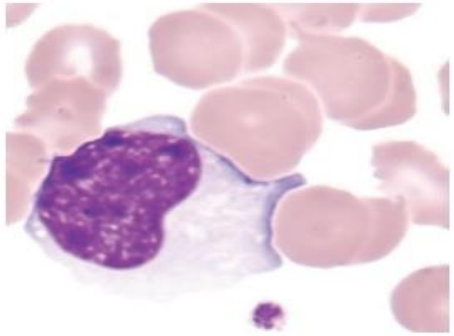
FIGURE 14-6C Normal segmented neutrophil for comparison.

REACTIVE LYMPHOCYTES



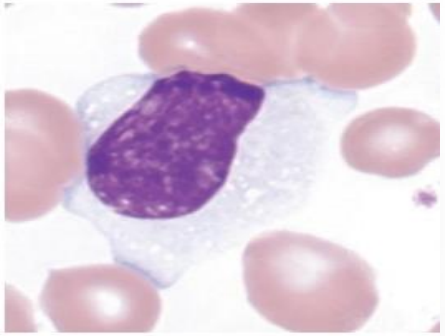
A

FIGURE 14–7A Reactive lymphocyte, vacuolated cytoplasm.



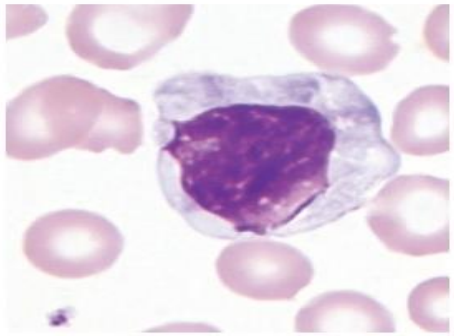
B

FIGURE 14–7B Reactive lymphocyte, peripheral basophilia.



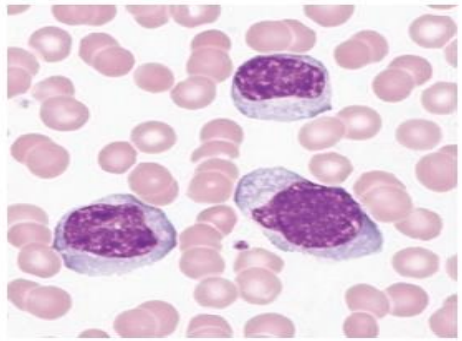
C

FIGURE 14–7C Reactive lymphocyte, cytoplasm indented by adjacent cells.



D

FIGURE 14–7D Reactive lymphocyte, radial basophilia.

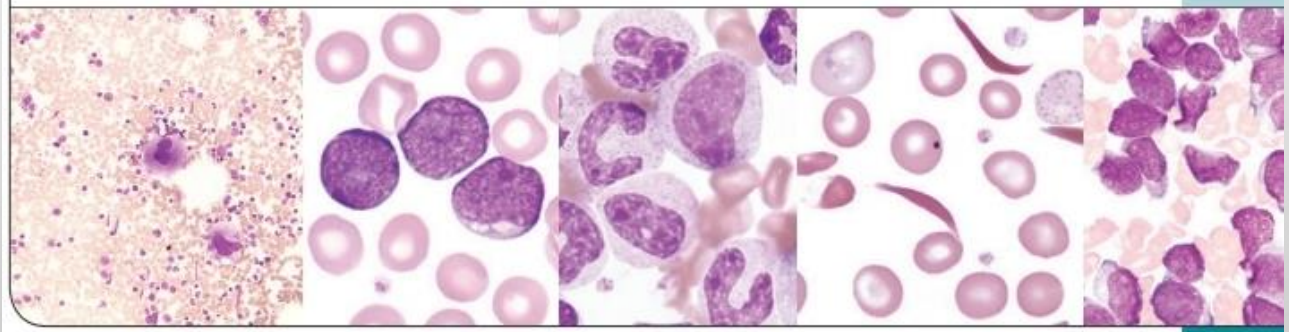


E

FIGURE 14–7E Reactive lymphocytes, characteristic of viral diseases, such as infectious mononucleosis (PB ×500).

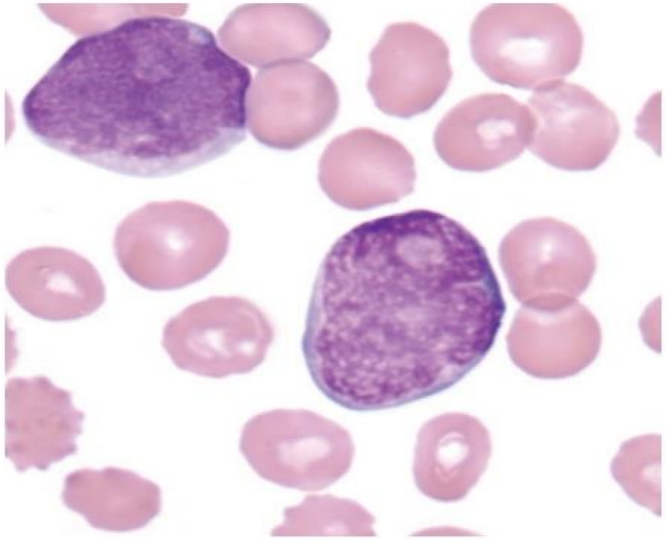
SHAPE: Pleomorphic; easily indented by surrounding cells
SIZE: 10-30 μm
NUCLEUS: Irregular
Nucleoli: Occasionally present
Chromatin: When compared with that of a resting lymphocyte, chromatin coarse to fine and dispersed.
CYTOPLASM: Pale blue to deeply basophilic, may stain unevenly with peripheral or radial basophilia
Granules: May have increased numbers of azurophilic granules
Vacuoles: Occasional
Associated with: Viral infections and other antigenic stimulation, including organ transplantation

ACUTE MYELOID LEUKEMIA



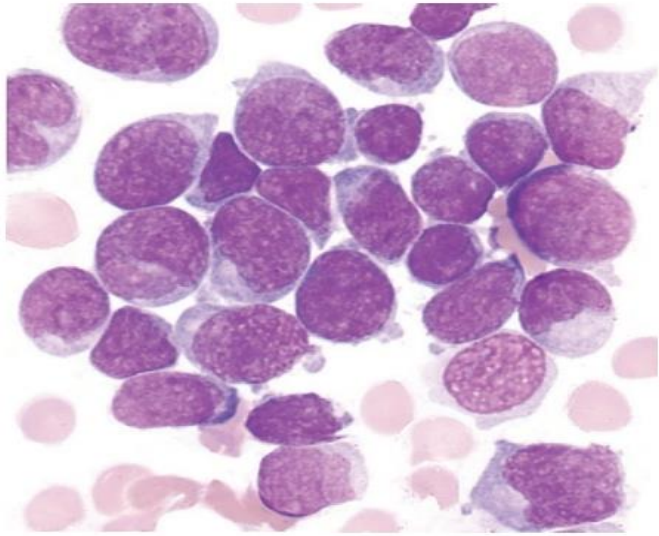
ACUTE MYELOID LEUKEMIA, MINIMALLY DIFFERENTIATED

FAB† M0



A

FIGURE 15–1A Peripheral blood (×1000).



B

FIGURE 15–1B Bone marrow (×500).

MORPHOLOGY

Peripheral Blood: Large agranular blasts

Bone Marrow: Large agranular blasts

CYTOCHEMISTRY

Myeloperoxidase: negative

Sudan Black B: negative

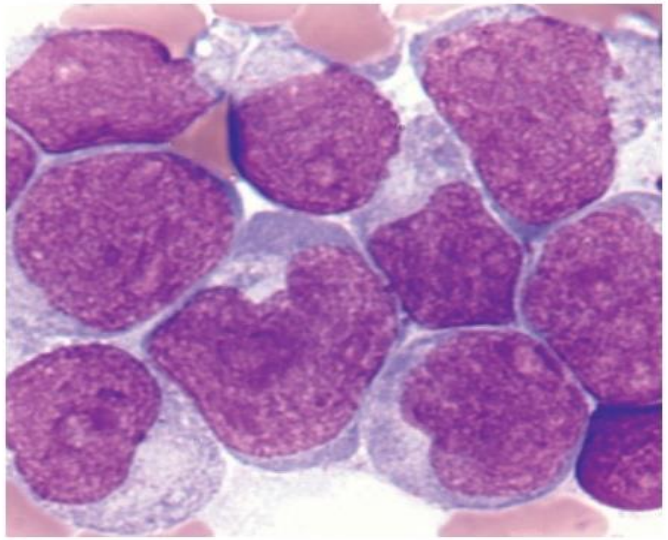
Nonspecific Esterase: negative

GENETICS

Recurrent genetic abnormalities: not defined

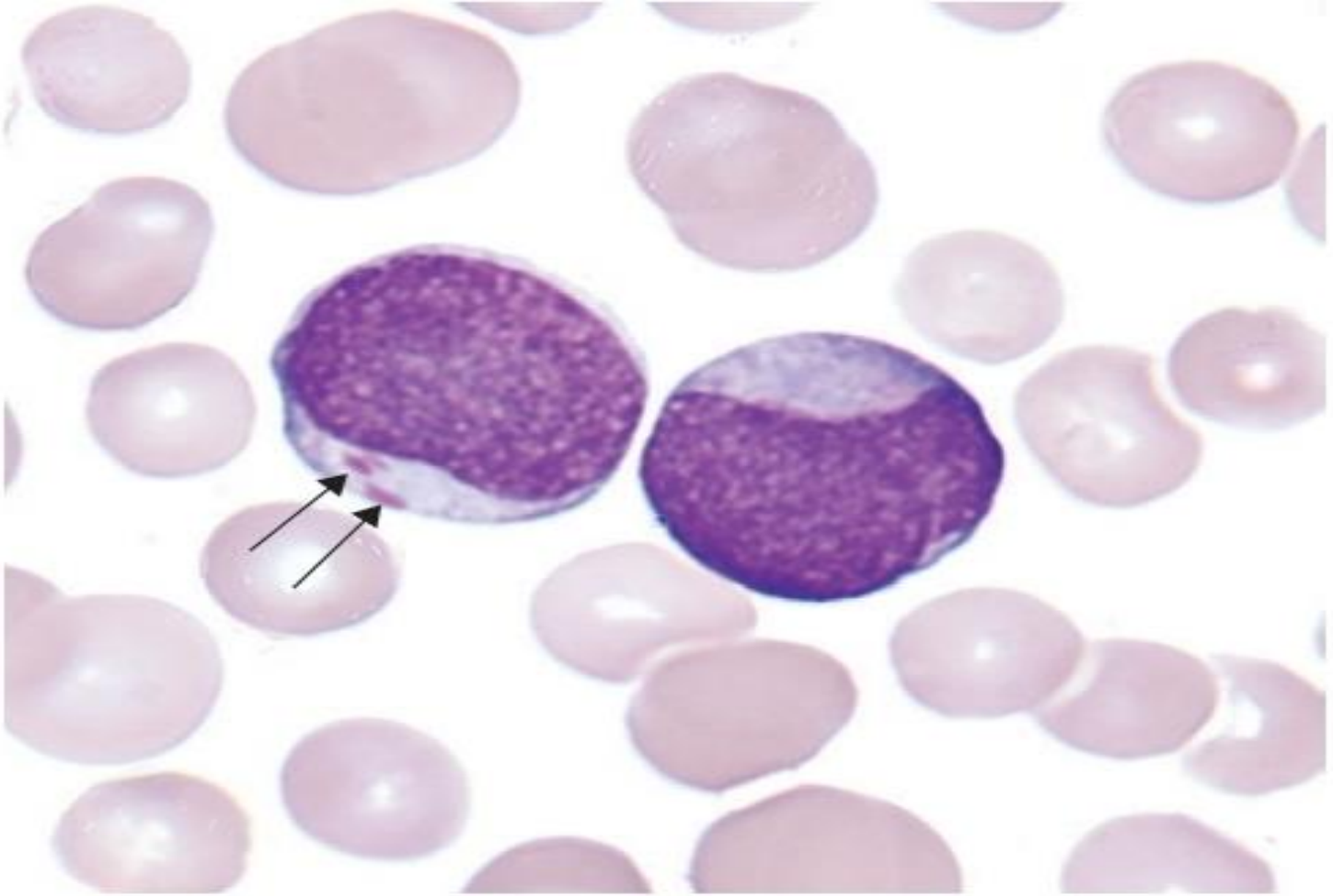
IMMUNOPHENOTYPE

$CD13^+$, $CD33^+$, $CD117^+$, HLA-$DR^{\pm}$, $CD34^{\pm}$, $CD38^+$



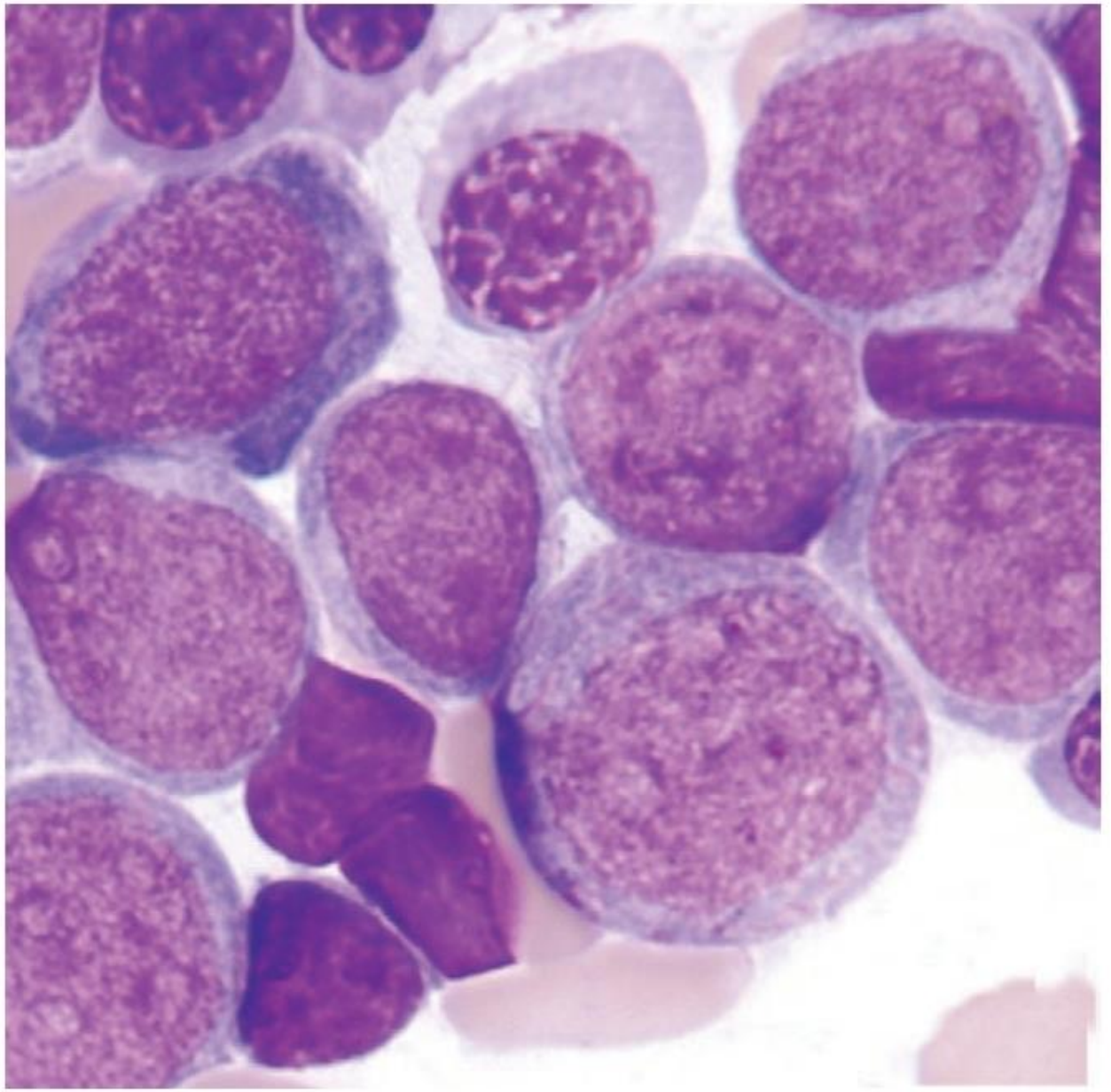
C

FIGURE 15–1C Bone marrow (×1000).



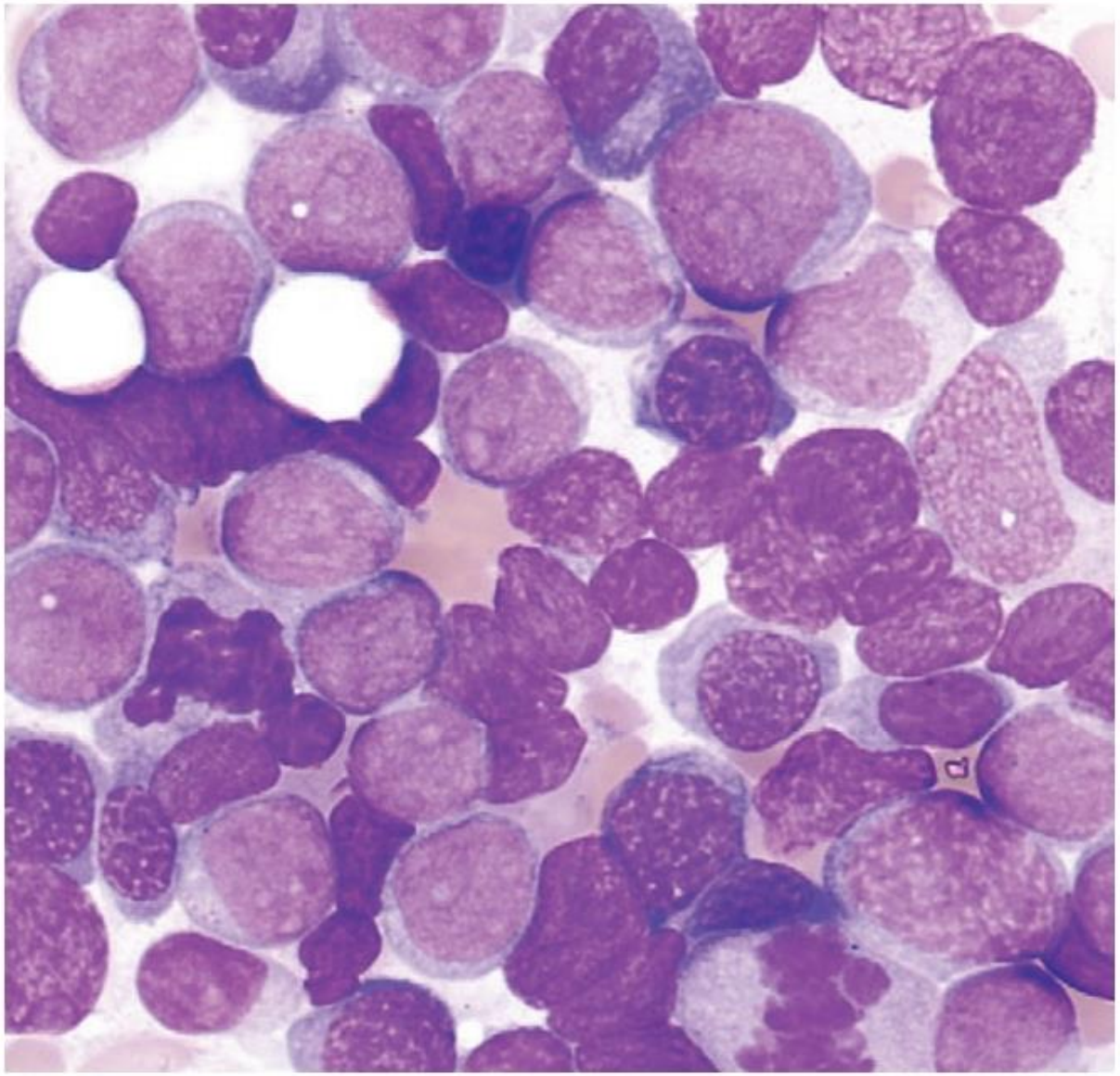
B

FIGURE 15–2B Peripheral blood: Auer rods in myeloblast (×1000). Auer rods are composed of fused primary granules usually rod shaped but may be round in appearance. Single or multiple Auer rods may be seen in malignant myeloblasts and malignant promyelocytes.



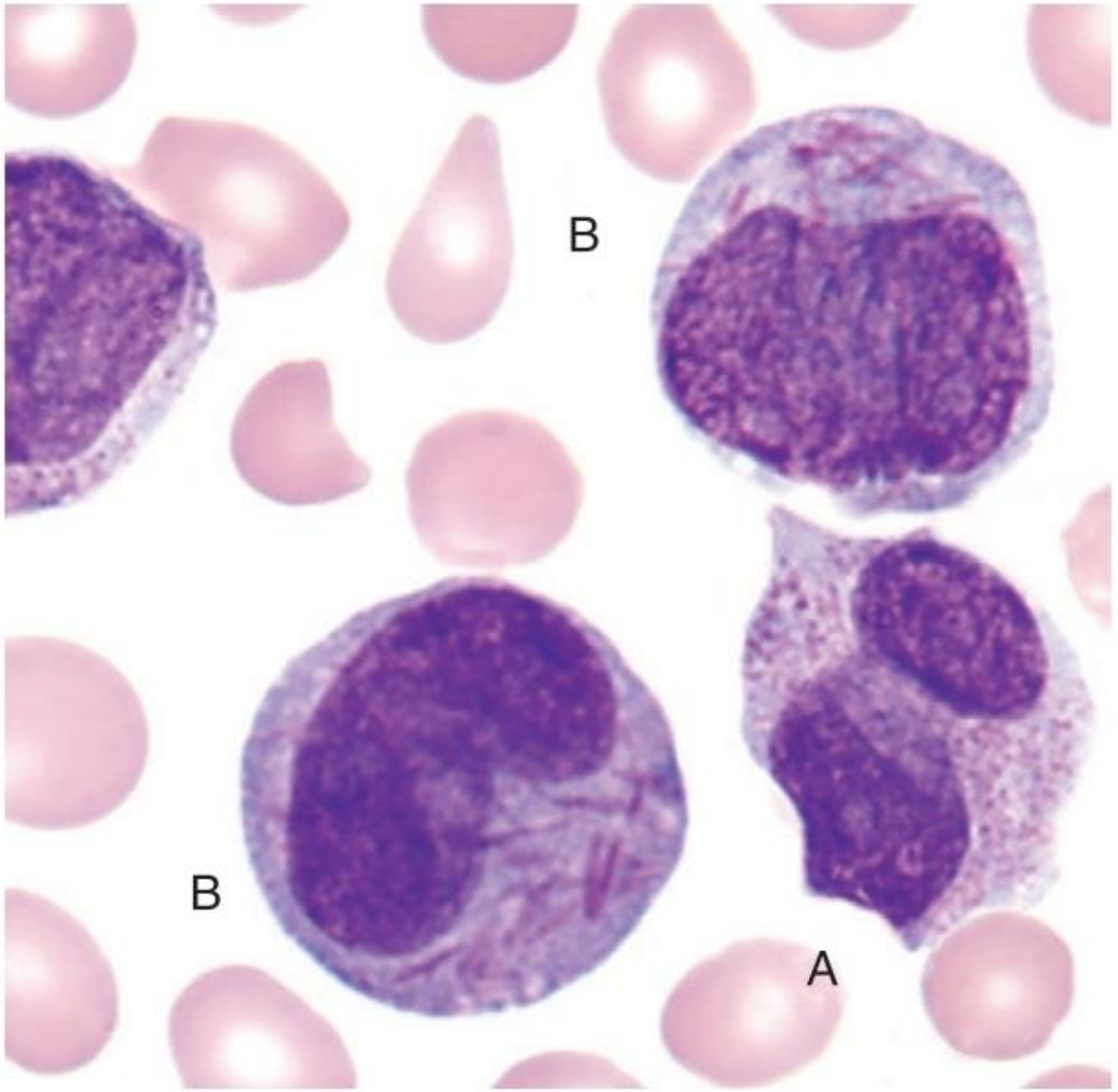
D

FIGURE 15–2D Bone marrow (×1000).



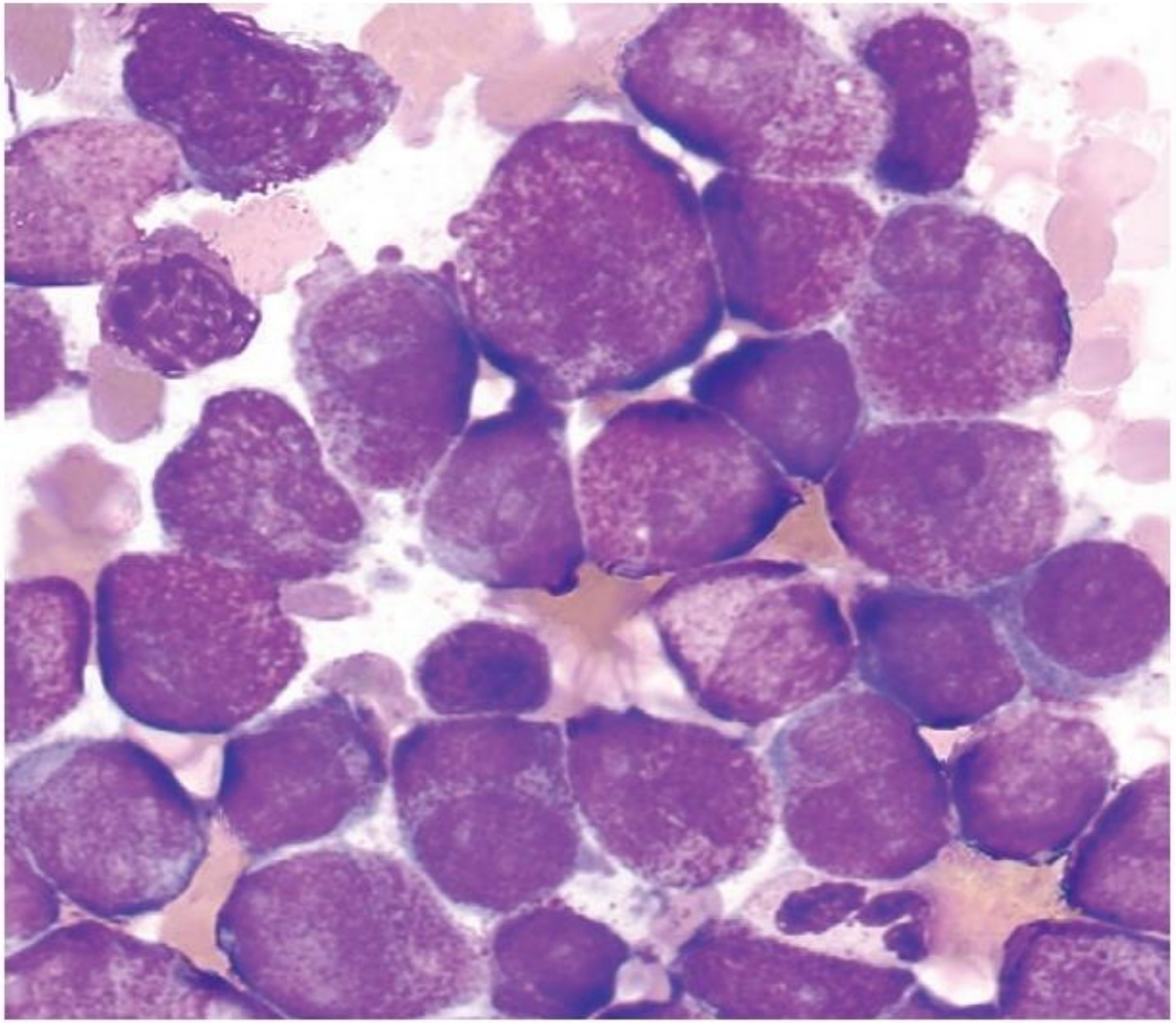
C

FIGURE 15–2C Bone marrow (×500).



A

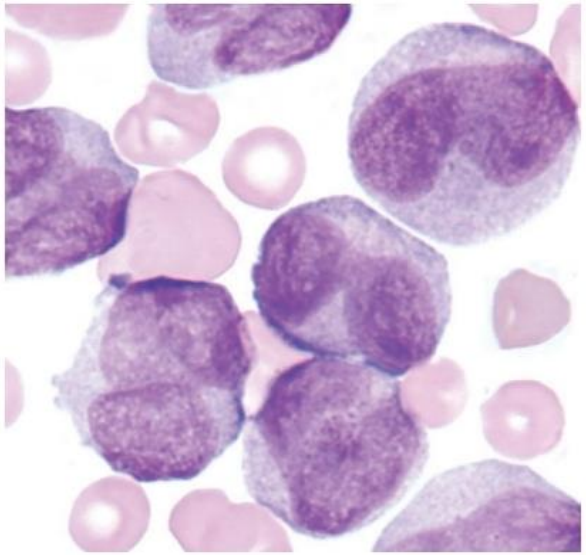
FIGURE 15–4A Peripheral blood. *A*, Hypergranular promyelocyte (×1000); *B*, Faggot cells.



B

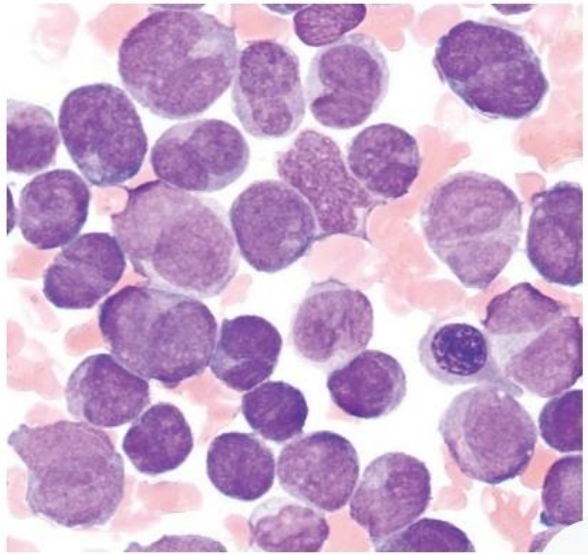
FIGURE 15–4B Bone marrow (×500).

ACUTE PROMYELOCYTIC LEUKEMIA—MICROGRANULAR VARIANT



A

FIGURE 15–5A Peripheral blood (×1000).



B

FIGURE 15–5B Bone marrow (×500).

MORPHOLOGY

Peripheral Blood: White blood cell count markedly elevated, deeply notched nuclei

Cytoplasm may appear agranular because of small size of granules, which are evident with electron microscopy

Bone Marrow: Agranular promyelocytes, with deeply notched nuclei

CYTOCHEMISTRY

Myeloperoxidase: strongly positive (see Figure 15-2, *E*)

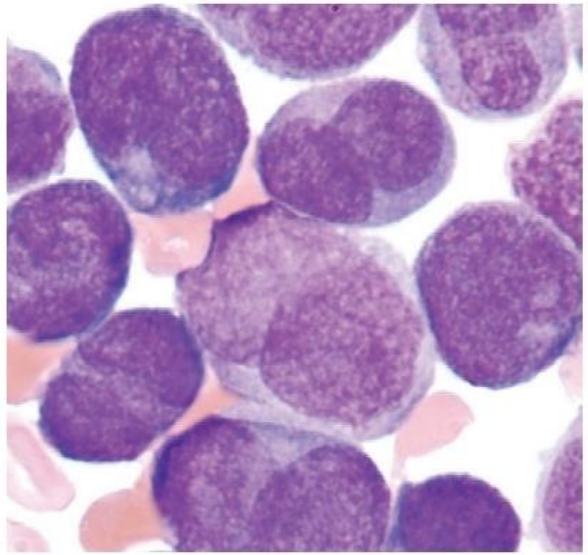
Sudan Black B: strongly positive (see Figure 15-2, *F*)

GENETICS

t(15;17) is sufficient for diagnosis as AML with recurrent genetic abnormalities regardless of blast/promyelocyte count.

IMMUNOPHENOTYPE

$CD13^{\pm}$, $CD33^{+}$, $CD34^{-}$, $HLA\text{-}DR^{-}$, $CD64^{+}$, $CD117^{\pm}$



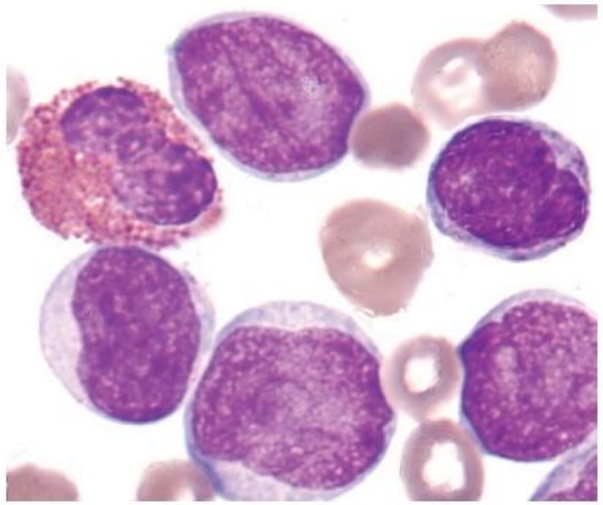
C

FIGURE 15–5C Bone marrow (×1000).

ACUTE MYELOID LEUKEMIA WITH inv(16) (p13.1q22) OR t(16;16)(p13.1;q22); CBFB-MYH11

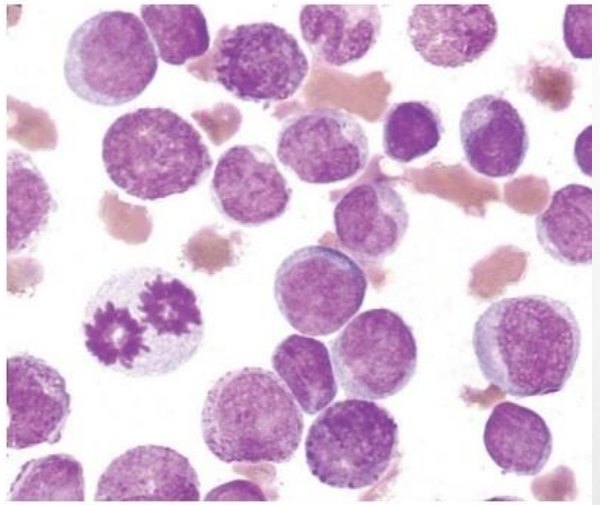
Acute myeloid leukemia with abnormal marrow eosinophils

FAB M4EO



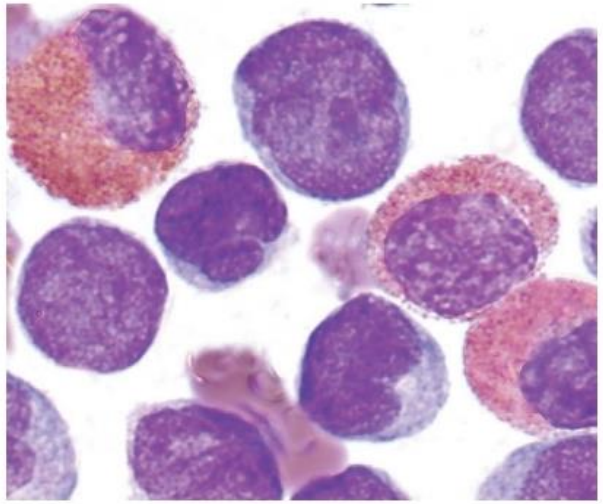
A

FIGURE 15–7A Peripheral blood (×1000).



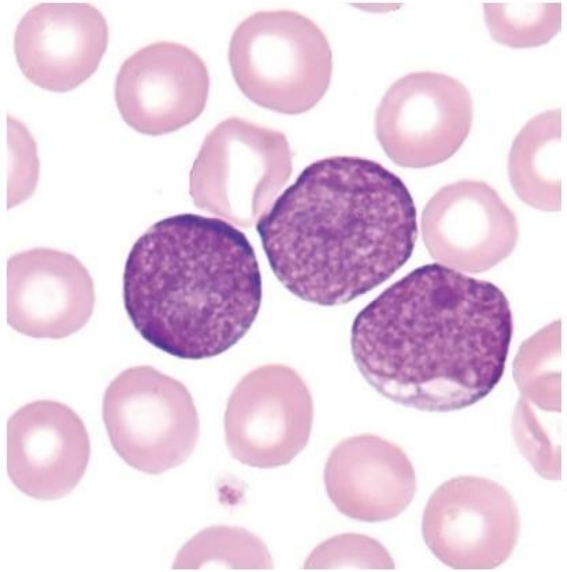
B

FIGURE 15–7B Bone marrow (×500).



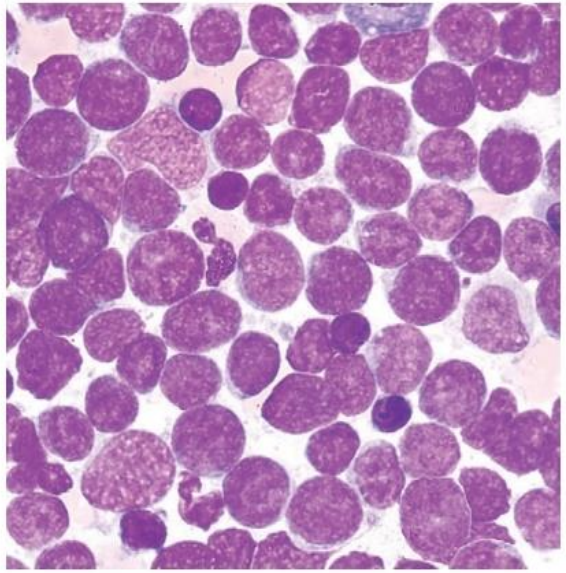
C

ACUTE LYMPHOBLASTIC LEUKEMIA, SMALL BLASTS



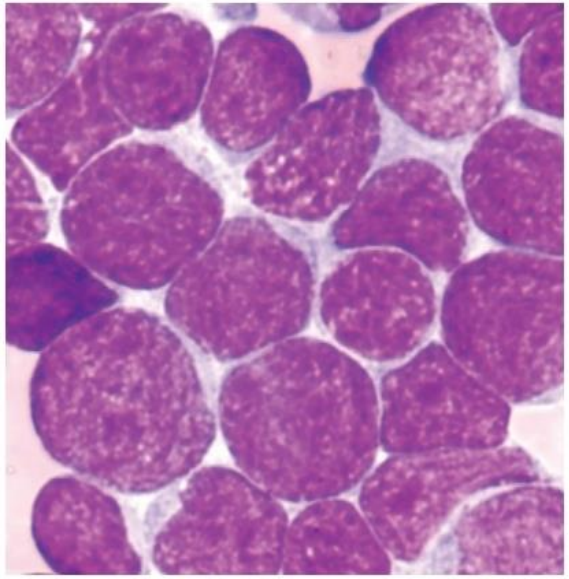
A

FIGURE 16–1A Peripheral blood (×1000).



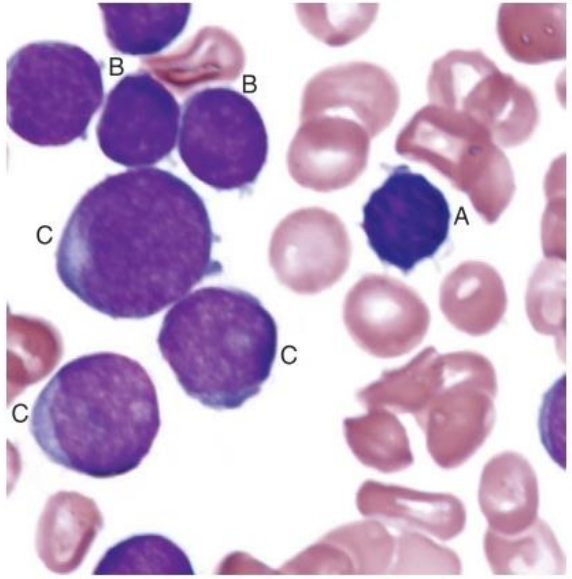
B

FIGURE 16–1B Bone marrow (×500).



C

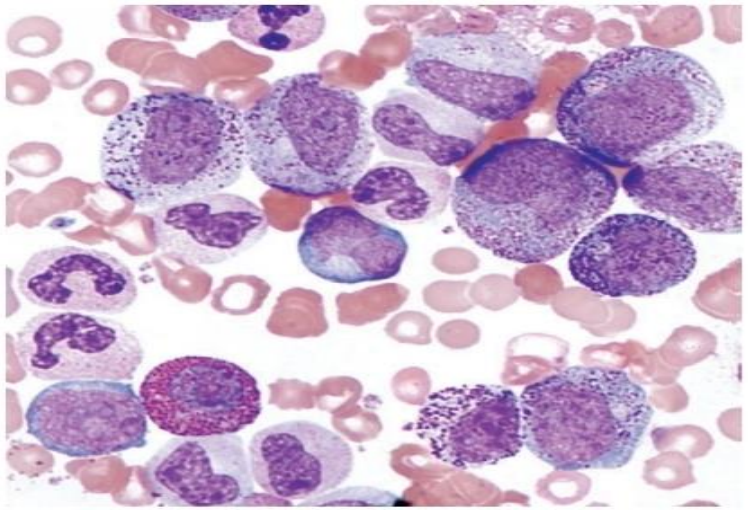
FIGURE 16–1C Bone marrow demonstrating



D

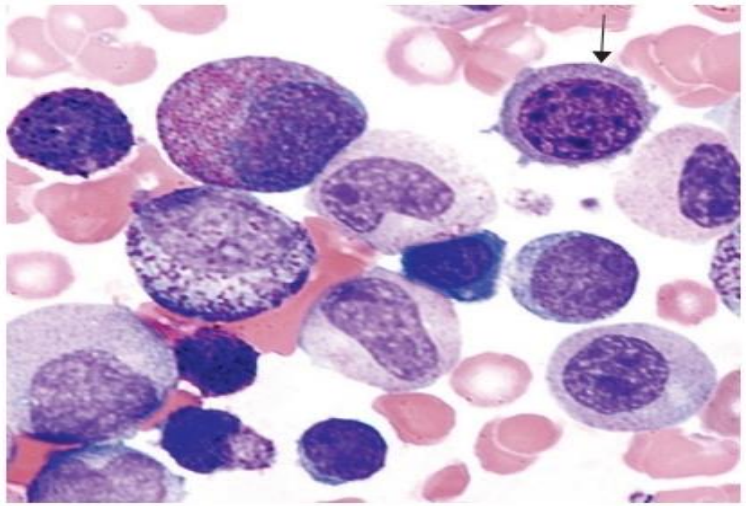
FIGURE 16–1D Bone marrow demonstrating the

CHRONIC MYELOGENOUS LEUKEMIA, BCR-ABL1 POSITIVE



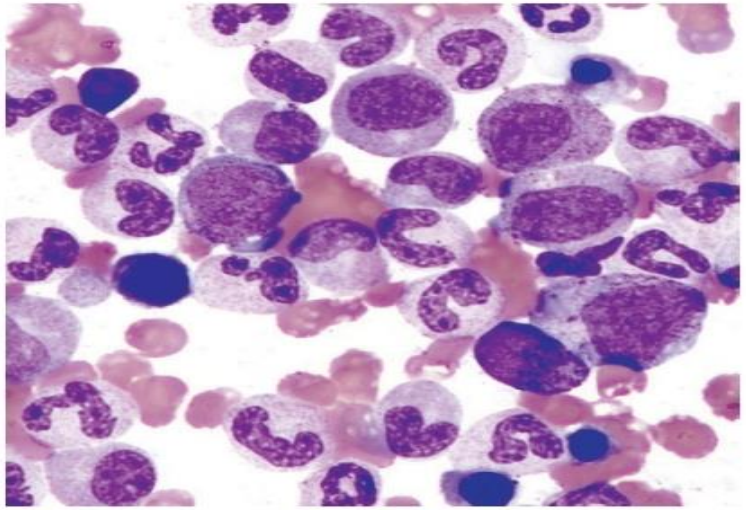
A

IGURE 17–1A Peripheral blood. Note immature asophils and eosinophil (Original size ×500).



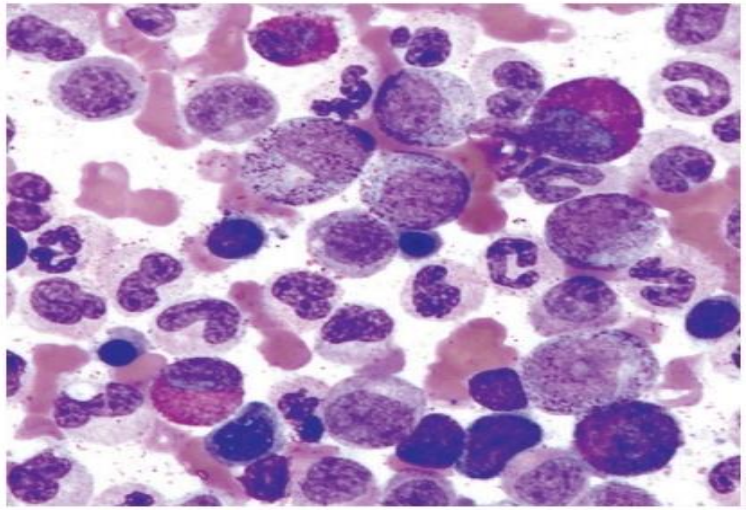
B

FIGURE 17–1B Peripheral blood. Arrow shows a micromegakaryocyte.



C

IGURE 17–1C BM ×500. A spectrum of ranulocytes, including multiple myelocytes, ands, and an immature basophil.

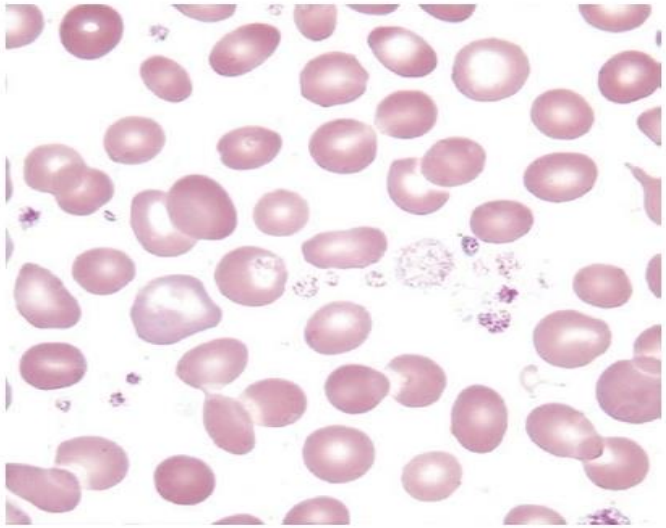


D

FIGURE 17–1D BM ×500. Multiple eosinophils, some of them immature.

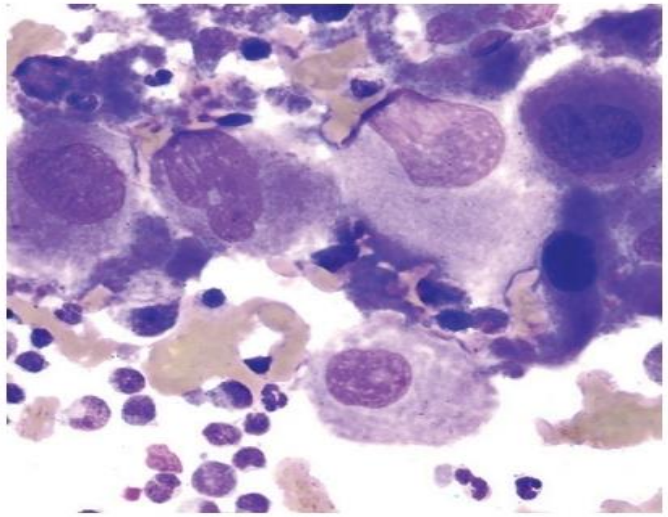
NOTE: BCR-ABL positivity must be present for diagnosis.

ESSENTIAL THROMBOCYTHEMIA



A

FIGURE 17–4A Peripheral blood (original magnification ×1000).



B

FIGURE 17–4B Bone marrow (original magnification ×500).

MORPHOLOGY

Peripheral Blood:

LEUKOCYTES

Normal or slightly increased
Normal maturation and distribution

ERYTHROCYTES

Normal or slightly decreased

PLATELETS

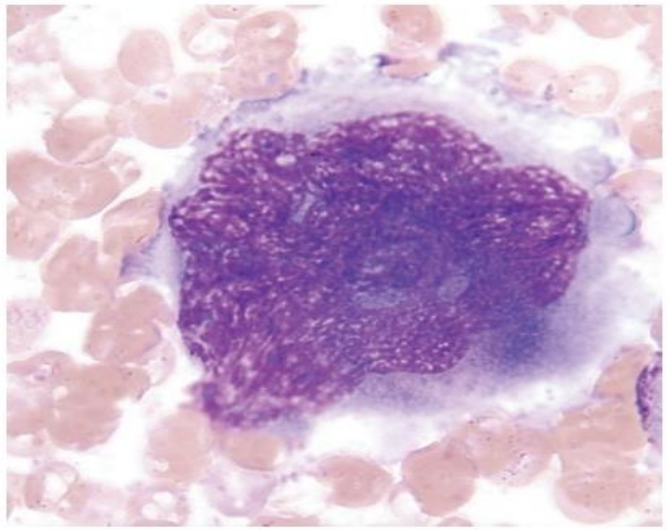
Marked sustained thrombocytosis
Variation in size from tiny to giant

Bone Marrow:

Hypercellular with expansion of the megakaryocyte pool

- Large megakaryocytes with abundant cytoplasm
- May exhibit hyperlobulation

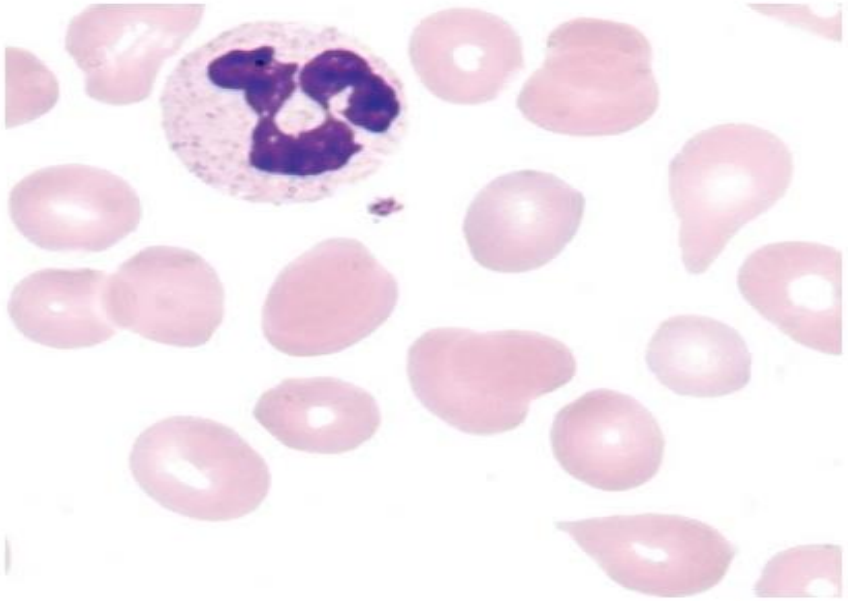
Mild granulocytic hyperplasia



C

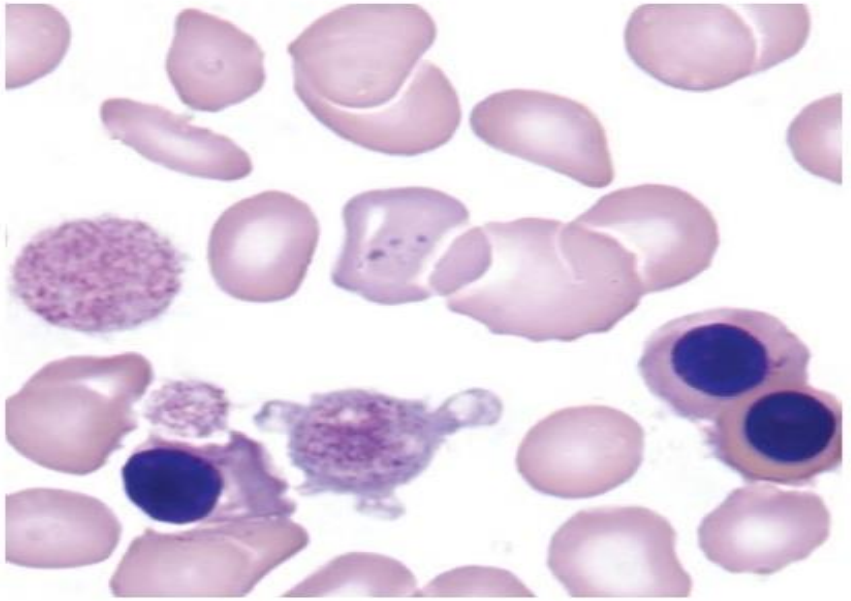
FIGURE 17–4C Bone marrow (original magnification ×1000).

PRIMARY MYELOFIBROSIS



A

FIGURE 17–5A Peripheral blood (×1000; subtle changes).



B

FIGURE 17–5B Peripheral blood (×1000; more advanced case).

MORPHOLOGY

Peripheral Blood:

LEUKOCYTES

Normal, increased, or decreased

- Immature granulocytes
- <5% blasts

ERYTHROCYTES

Normal or decreased

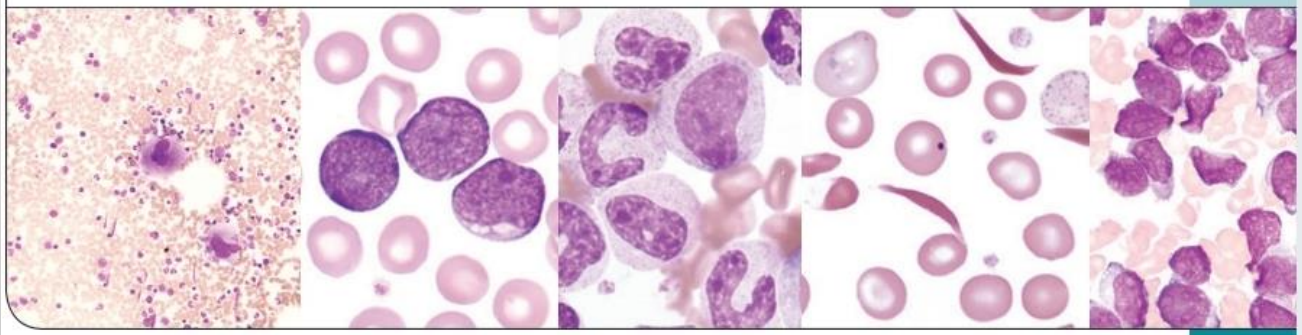
- Tear drop cells common, nucleated erythrocytes, polychromasia

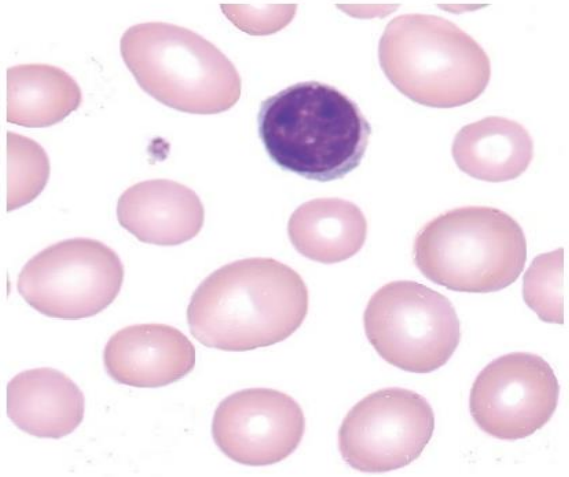
PLATELETS

Low, normal, or increased

- May be giant with atypical shapes

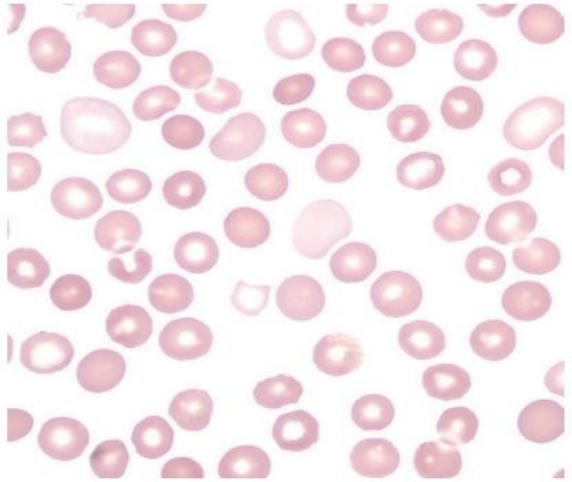
MYELODYSPLASTIC SYNDROMES





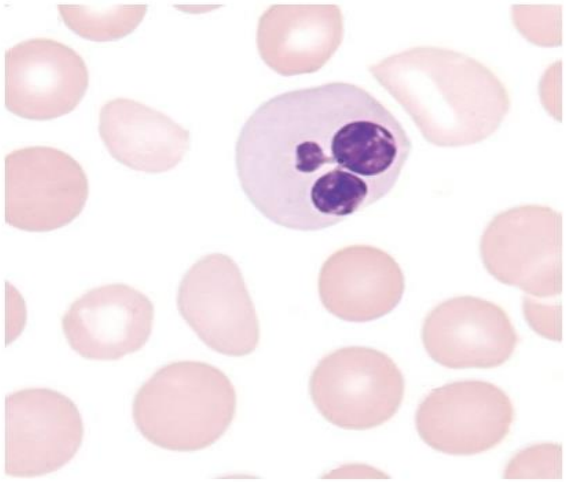
A

FIGURE 18–1A Oval macrocytes (PB ×1000).



B

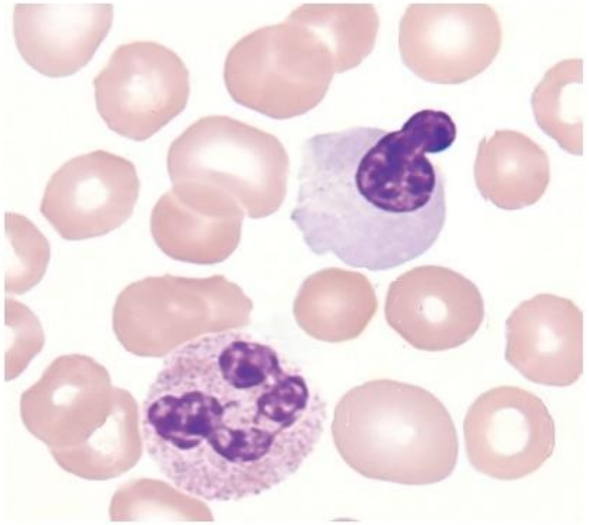
FIGURE 18–1B Dimorphic erythrocyte population (PB ×500).



C

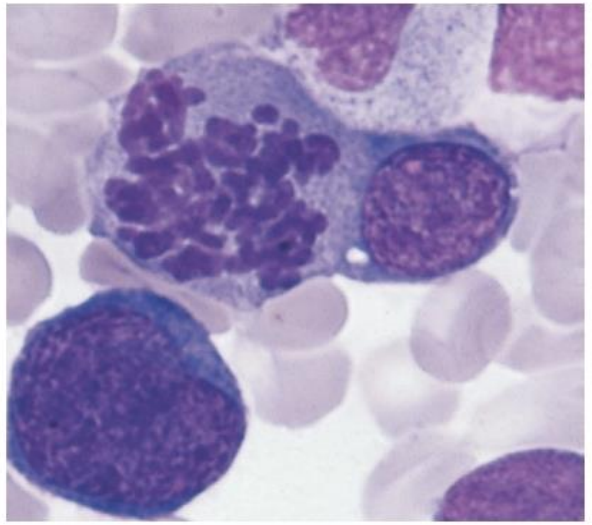
FIGURE 18–1C Nucleated erythrocyte with abnormal nuclear shape (PB ×1000).

Evidence of dyserythropoiesis (Figure 18-1, *A-I*) may include any or all of the following: oval macrocytes, hypochromic microcytes, dimorphic erythrocyte population, erythrocyte precursors with more than one nucleus, abnormal nuclear shapes, nuclear bridging, uneven cytoplasmic staining, and/or ringed sideroblasts.



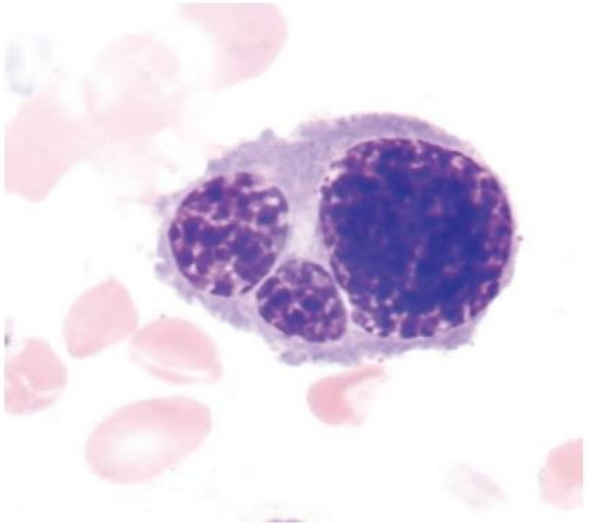
D

FIGURE 18–1D Erythrocyte precursor with partial loss of nucleus (PB ×1000).



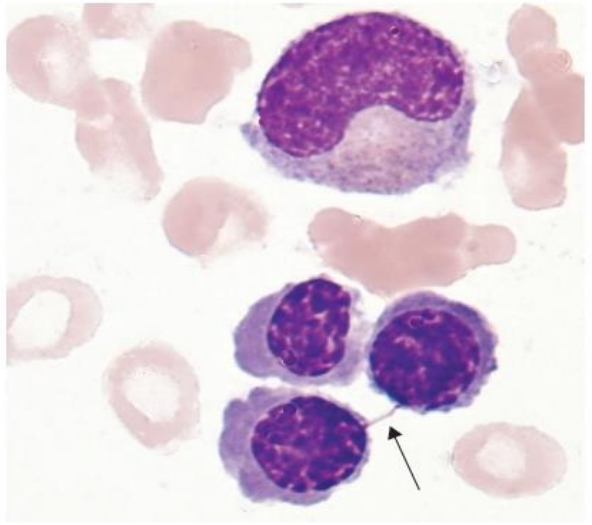
E

FIGURE 18–1E Erythrocyte precursor with abnormal nuclear shape (bilobed, with one nucleus in mitosis, demonstrating asynchrony; BM ×1000).



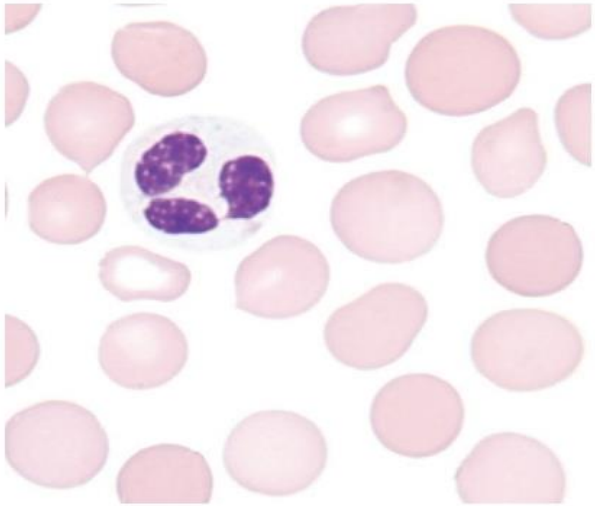
F

FIGURE 18–1F Erythrocyte precursor with three uneven nuclei (BM ×1000).



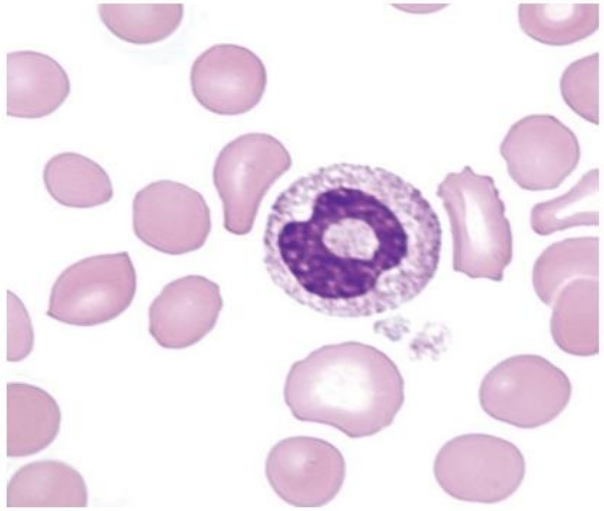
G

FIGURE 18–1G Erythrocyte precursor with nuclear bridging (BM ×1000).



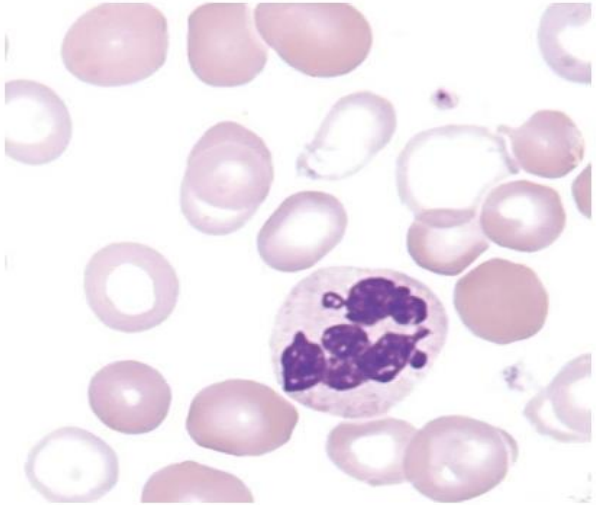
A

FIGURE 18–2A Abnormal granulation, agranular segmented neutrophil.



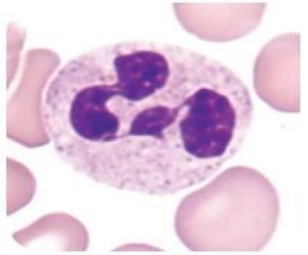
B

FIGURE 18–2B Abnormal nuclear shapes, neutrophil with circular (donut) nucleus.



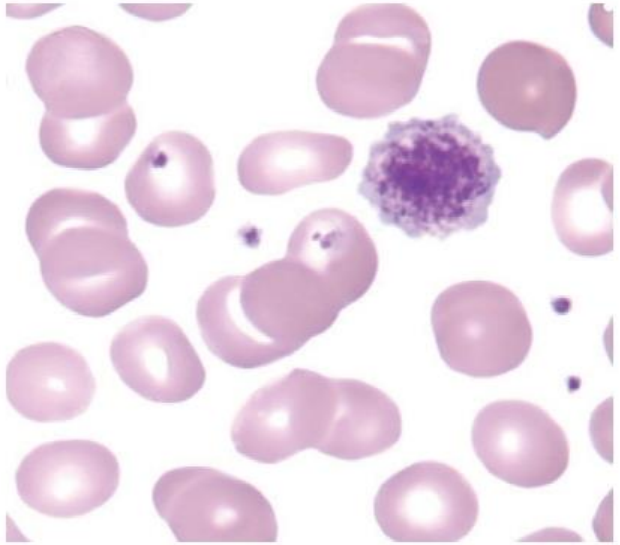
C

FIGURE 18–2C Abnormal nuclear shapes, neutrophil with hypersegmented nucleus; also exhibits hypogranulation.



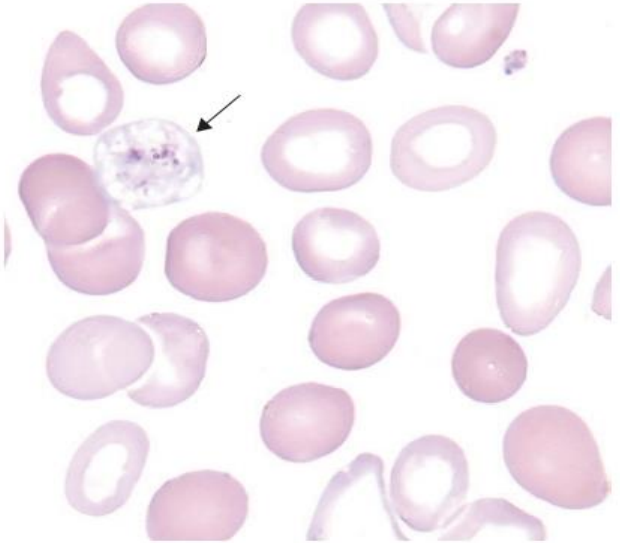
Normal neutrophil for comparison.

DYSMEGAKARYOPOIESIS



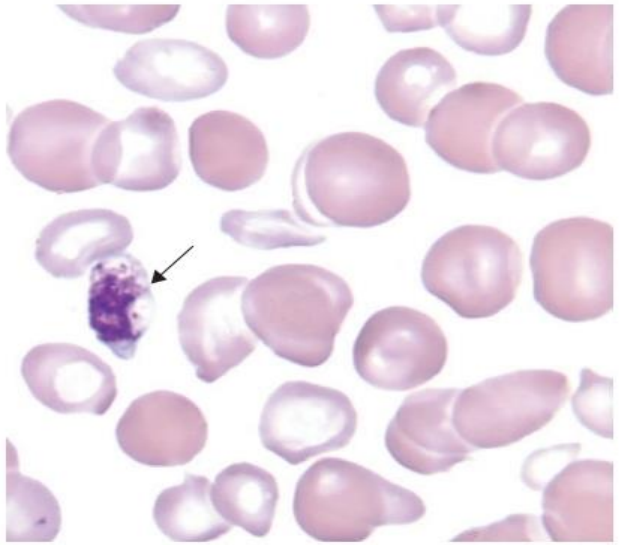
A

FIGURE 18–3A Giant platelet.



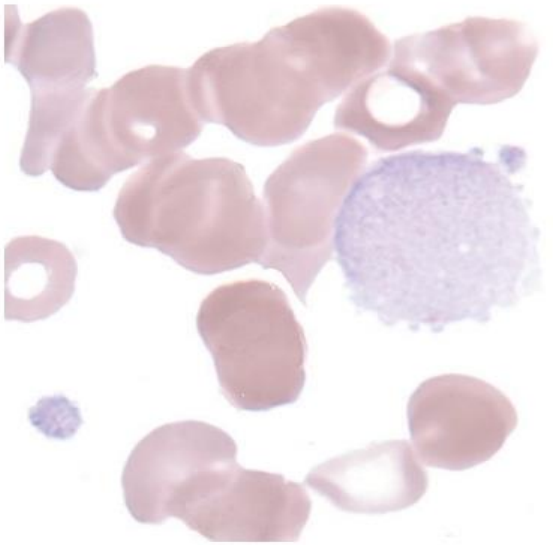
B

FIGURE 18–3B Platelet with hypogranulation.



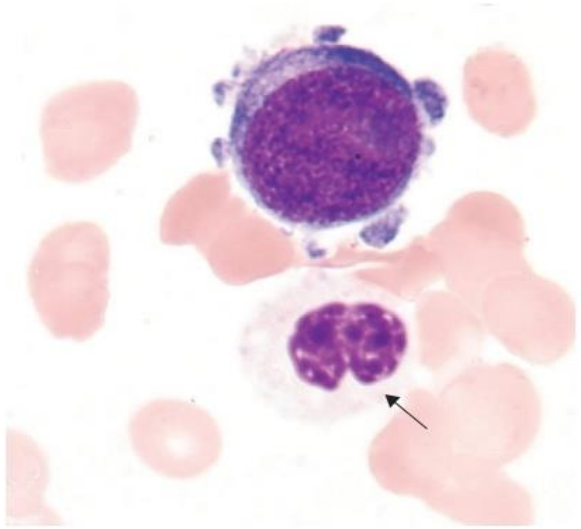
C

FIGURE 18–3C Platelet with hypergranulation.



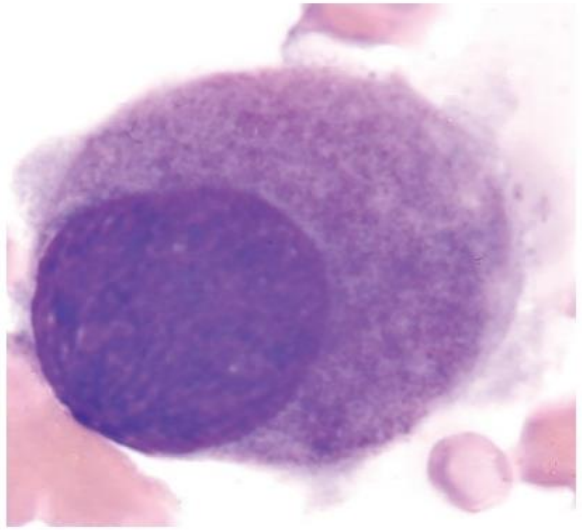
D

FIGURE 18–3D Giant platelet.



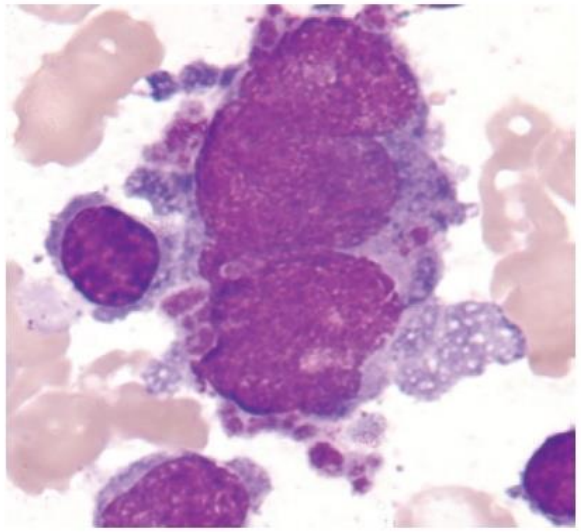
E

FIGURE 18–3E Circulating micromegakaryocyte. Hypogranular pseudo-Pelger-Hüet cell at *arrow*.



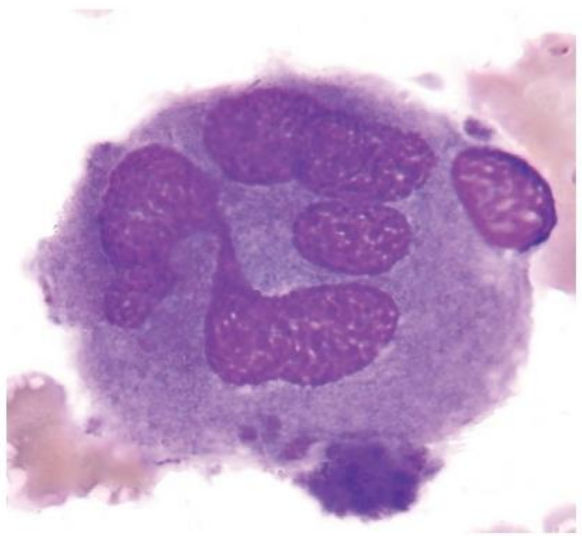
F

FIGURE 18–3F Large mononuclear megakaryocyte (BM ×1000).



G

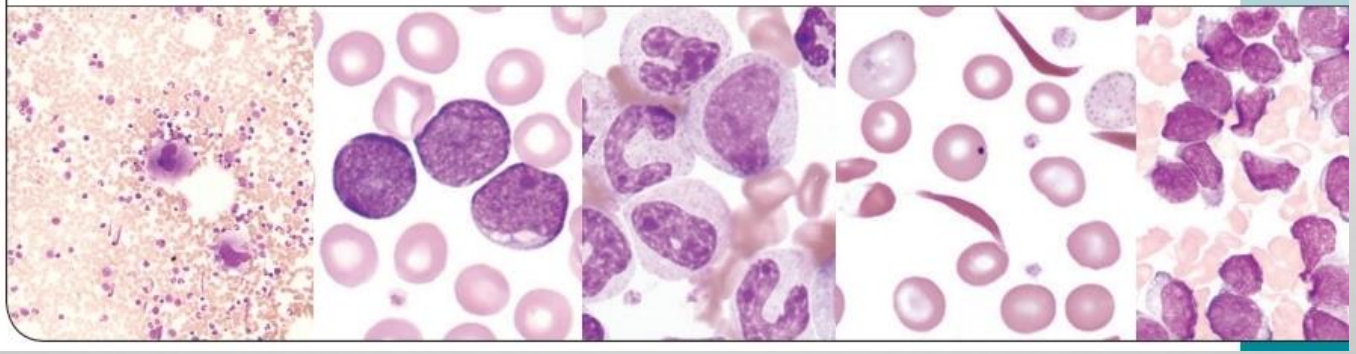
FIGURE 18–3G Abnormal nuclear shape, uneven number of nuclei (BM ×1000).



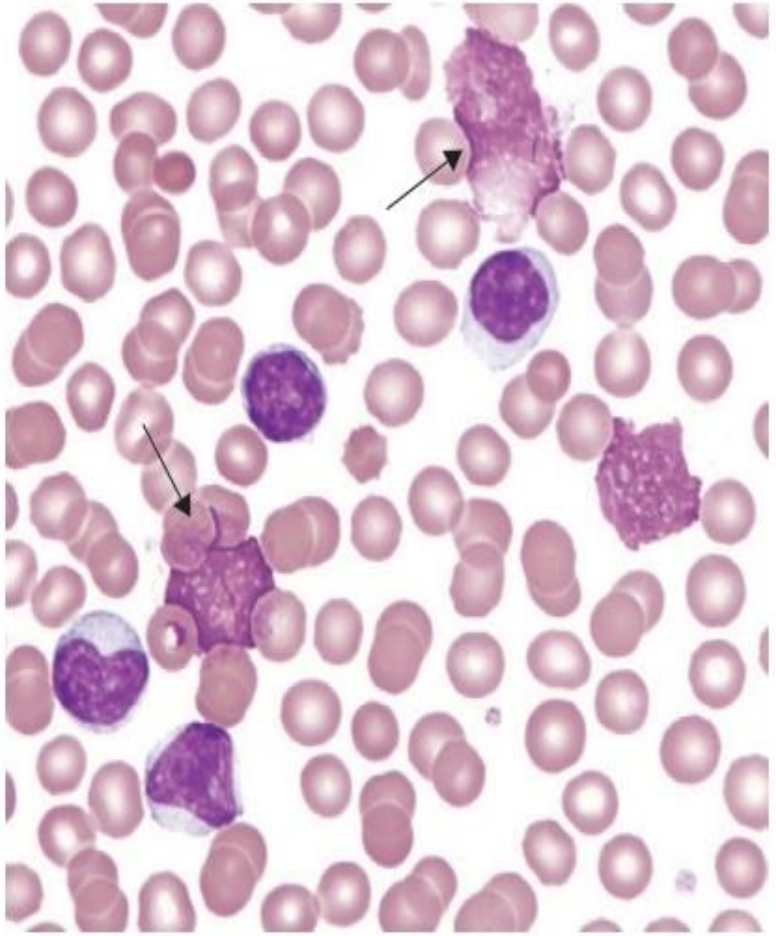
H

FIGURE 18–3H Abnormal nuclear shapes, separate nuclei (BM, original magnification ×1000).

MATURE LYMPHOPROLIFERATIVE DISORDERS

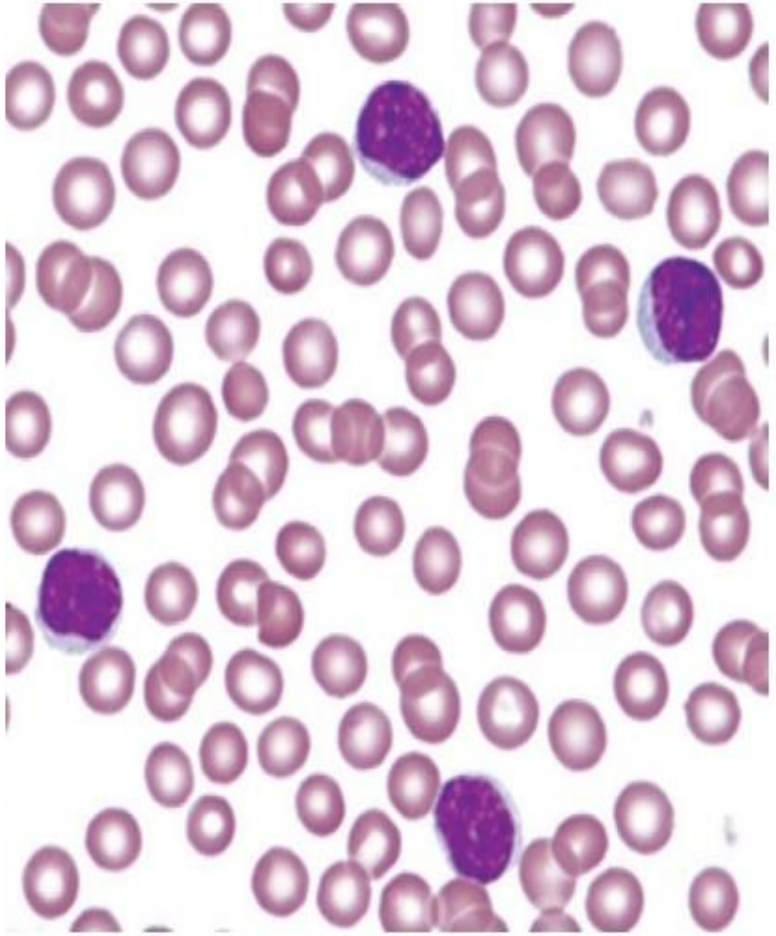


CHRONIC LYMPHOCYTIC LEUKEMIA



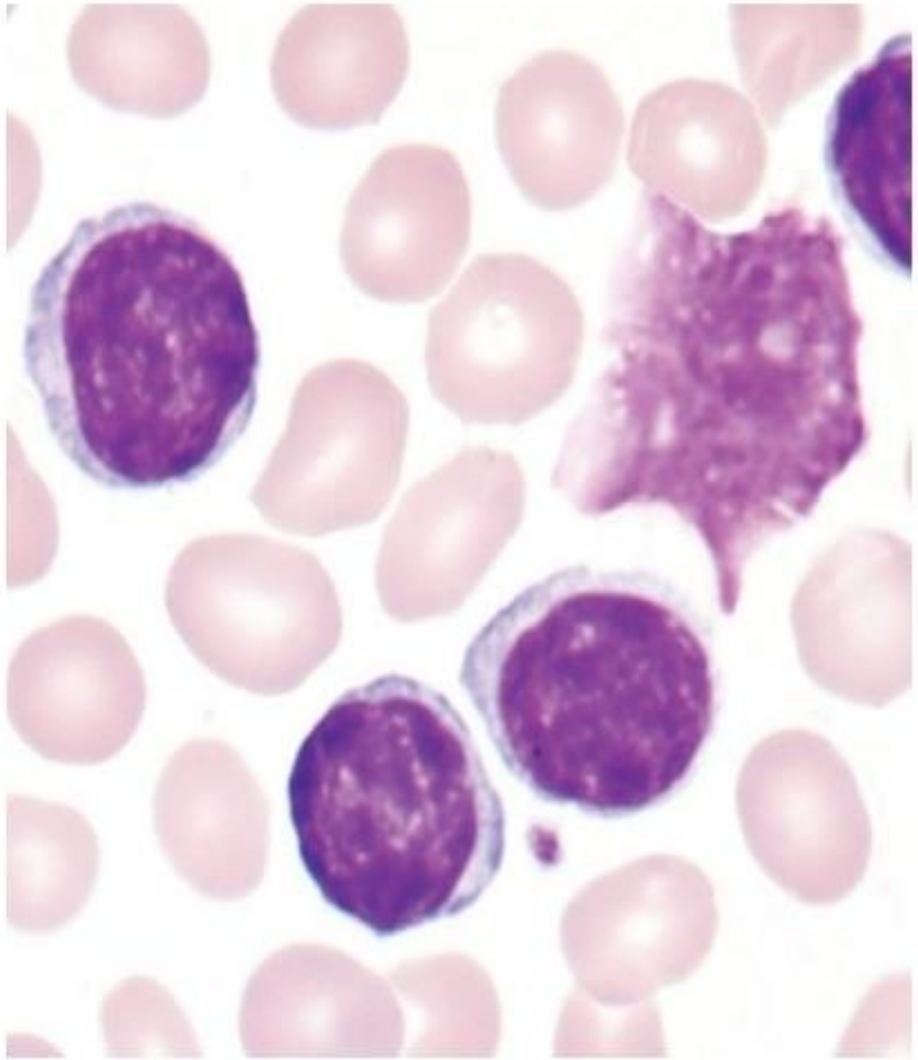
A

FIGURE 19–1A Small lymphocytes with smudge cells at *arrows* (PB ×500).



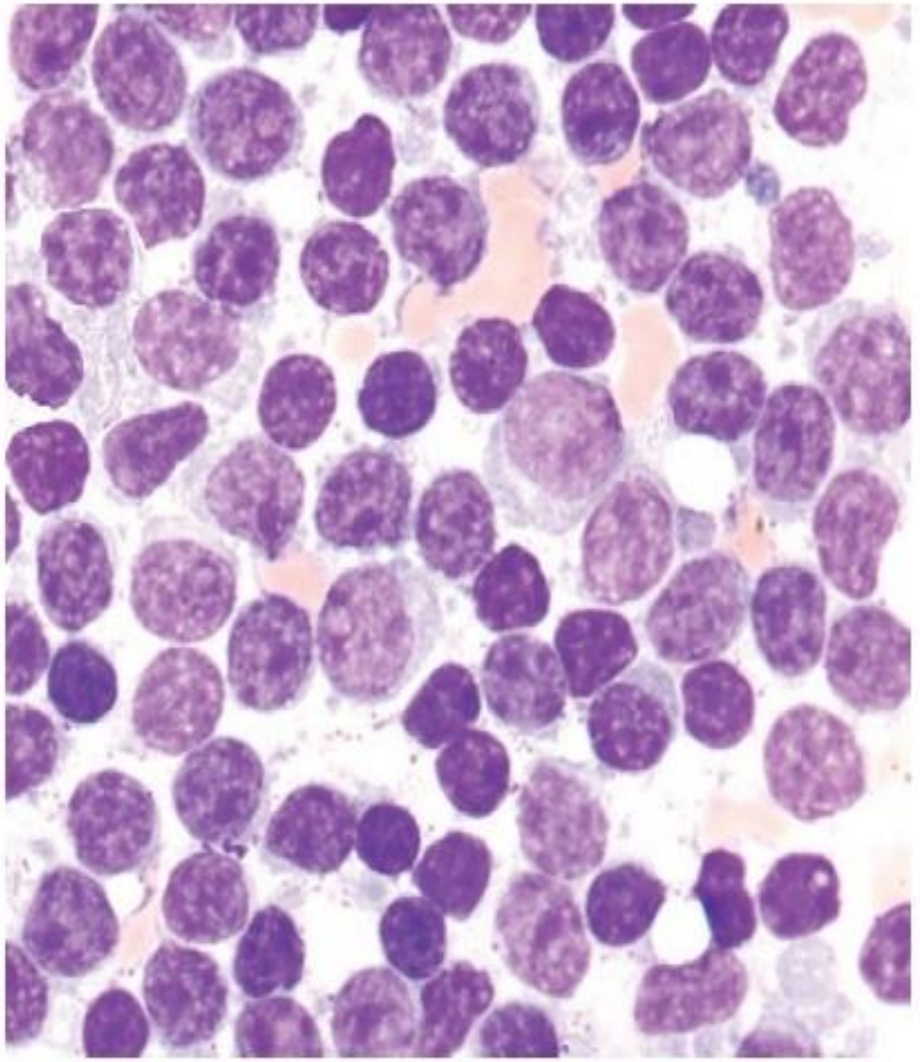
B

FIGURE 19–1B Albumin smear-same patient as presented in figure 19-1A (PB ×500).



C

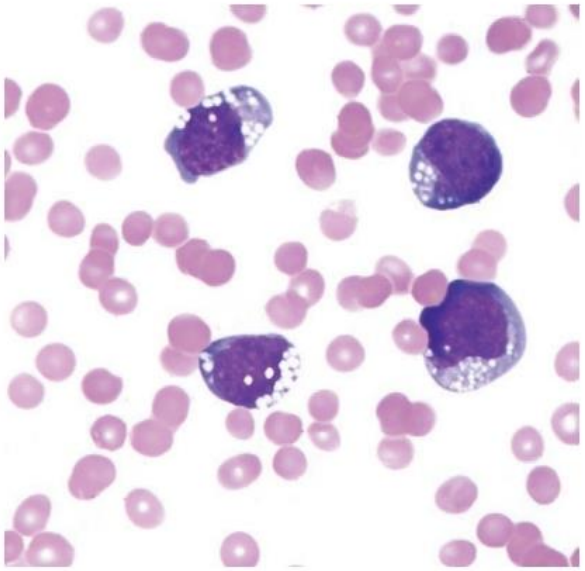
FIGURE 19–1C Small lymphocytes with smudge cell (PB ×1000).



D

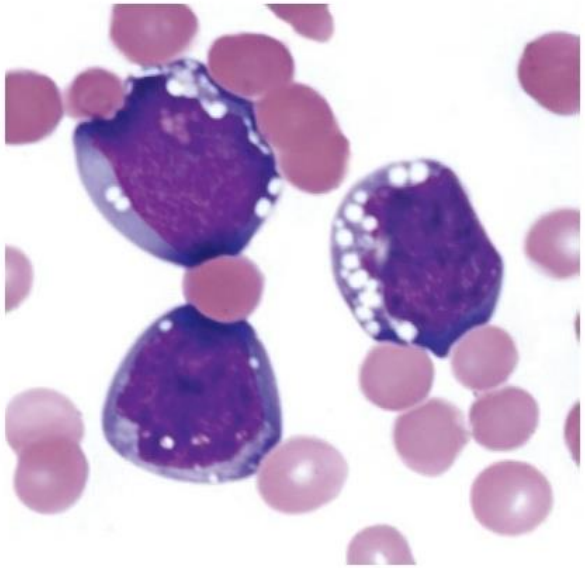
FIGURE 19–1D (BM ×500).

BURKITT LEUKEMIA/LYMPHOMA



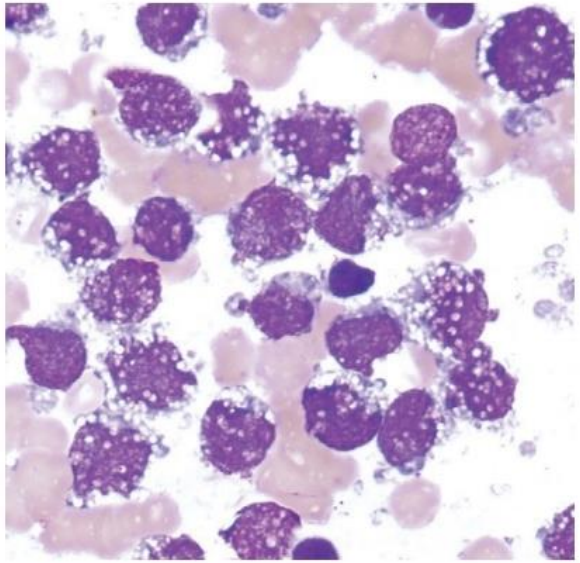
A

FIGURE 19–5A (PB ×500).



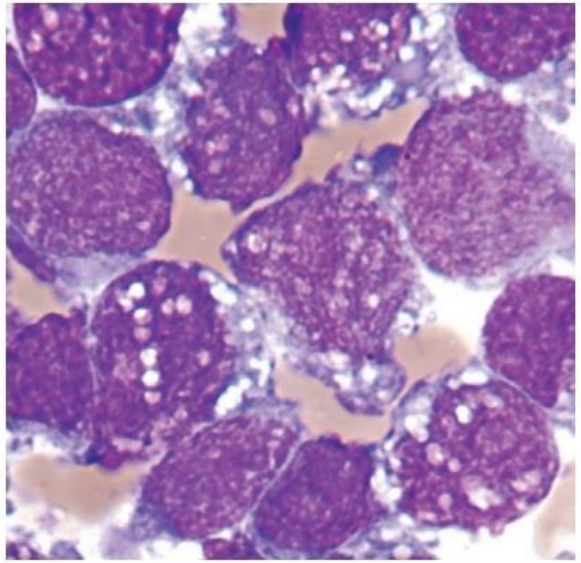
B

FIGURE 19–5B (PB ×1000).



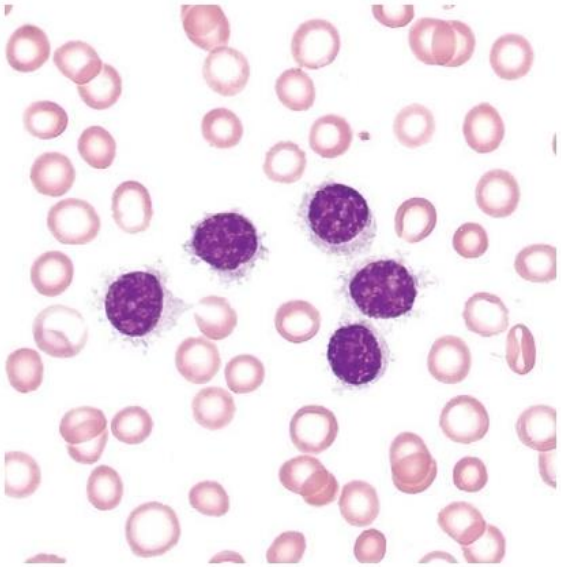
C

FIGURE 19–5C (BM ×500).



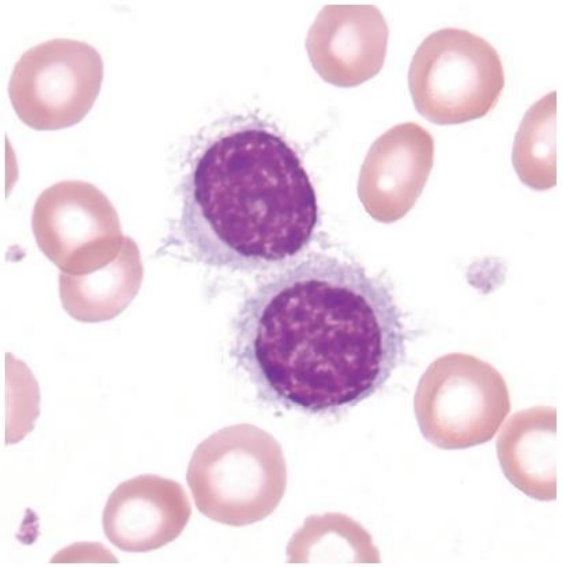
D

FIGURE 19–5D (BM ×1000).



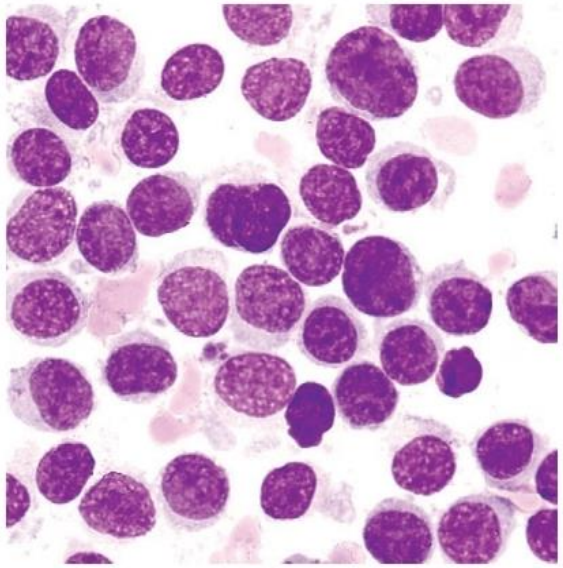
A

FIGURE 19–3A (PB ×500).



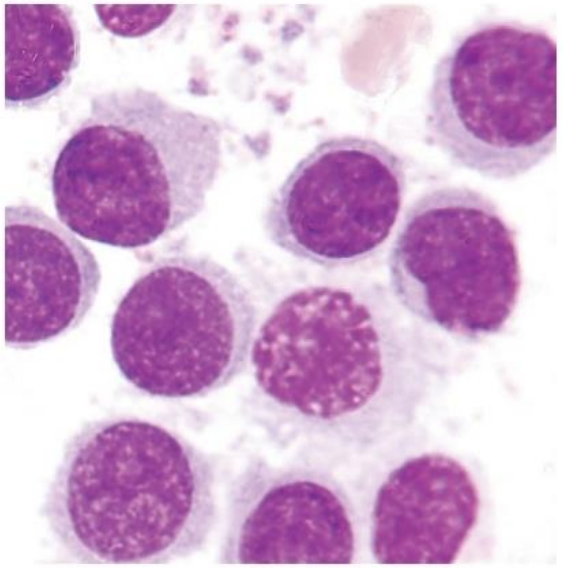
B

FIGURE 19–3B (PB ×1000).



C

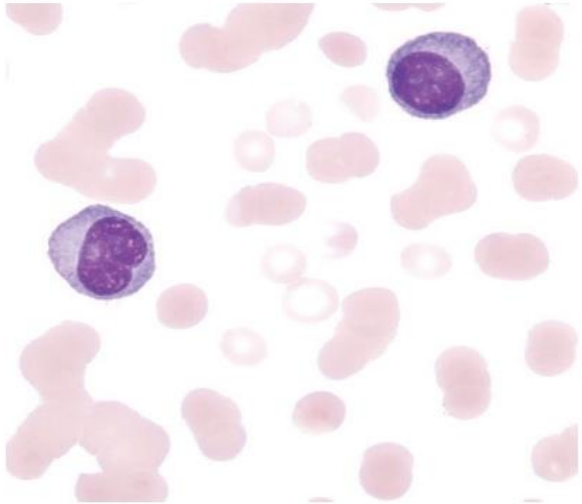
FIGURE 19–3C (BM ×500).



D

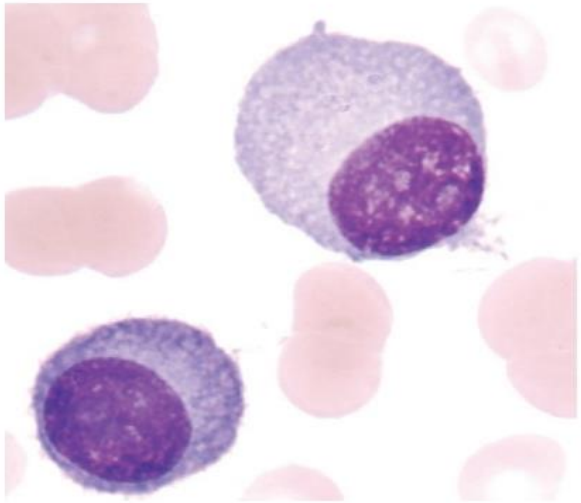
FIGURE 19–3D (BM ×1000).

PLASMA CELL MYELOMA



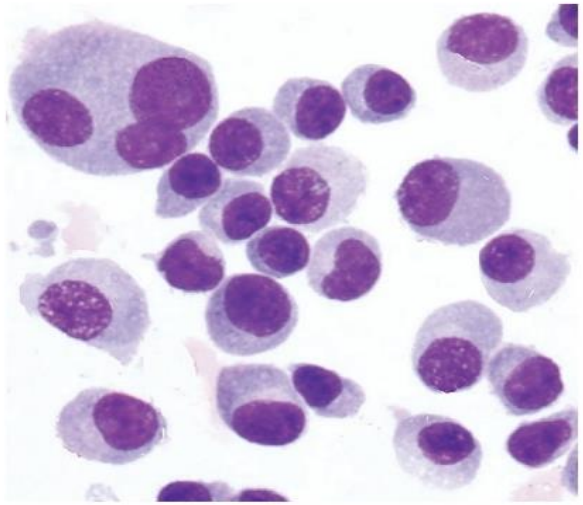
A

FIGURE 19–4A Plasma cells. Note rouleaux (PB ×500).



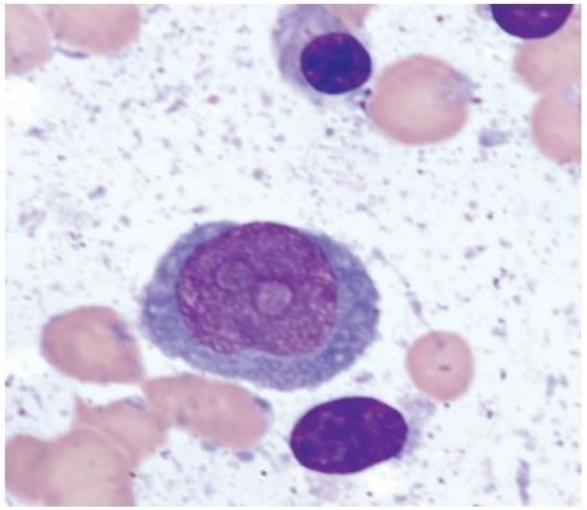
B

FIGURE 19–4B Plasma cells (PB ×1000).



C

FIGURE 19–4C Plasma cells, one multi-nucleated (BM ×500).

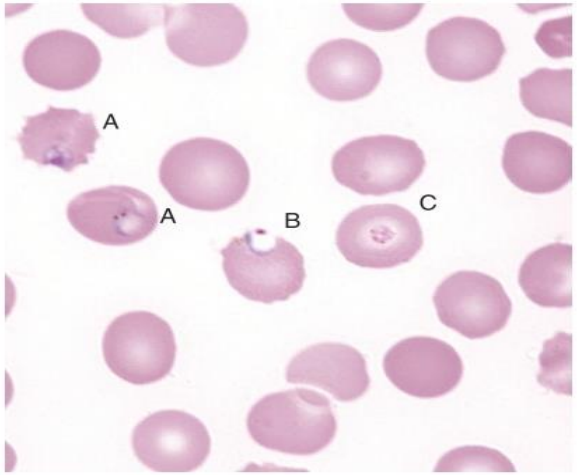


D

FIGURE 19–4D Plasmablast (BM ×1000). Note the lighter blue cytoplasm with the indistinct hof and the slightly eccentric nucleus with 2 distinct nucleoli.

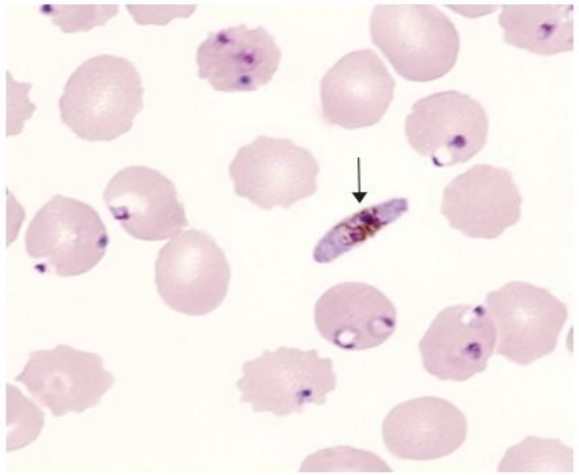
PLASMODIUM SPECIES

The following examples are representative of the developmental stages of malaria that can be seen in the peripheral blood. Detailed criteria for identification of species may be found in a parasitology text.



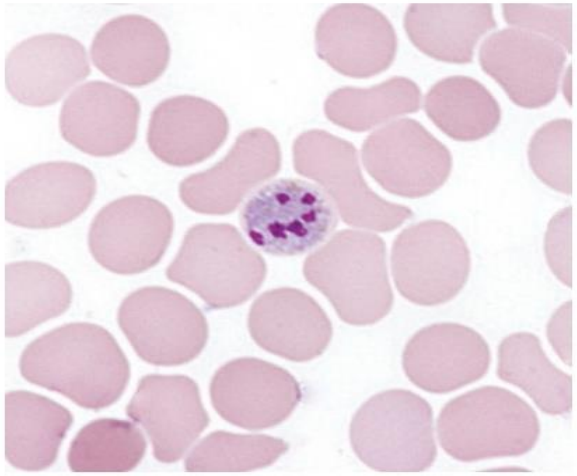
A

FIGURE 21–1A *Plasmodium falciparum* rings (*A*), including applique form (*B*), and platelet on RBC (*C*) (PB ×1000). (Courtesy Indiana Pathology Images).



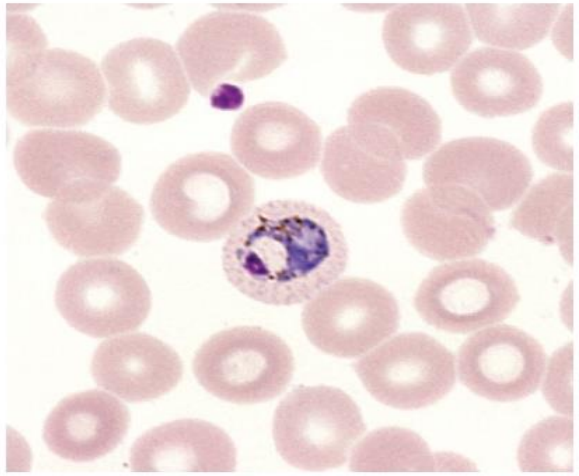
B

FIGURE 21–1B *Plasmodium falciparum* rings and crescent (banana-shaped) gametocyte (*arrow*) (PB ×1000). (Courtesy Indiana Pathology Images).



C

FIGURE 21–1C *Plasmodium malariae* schizont (with



D

FIGURE 21–1D *Plasmodium vivax;* growing

BABESIA SPECIES

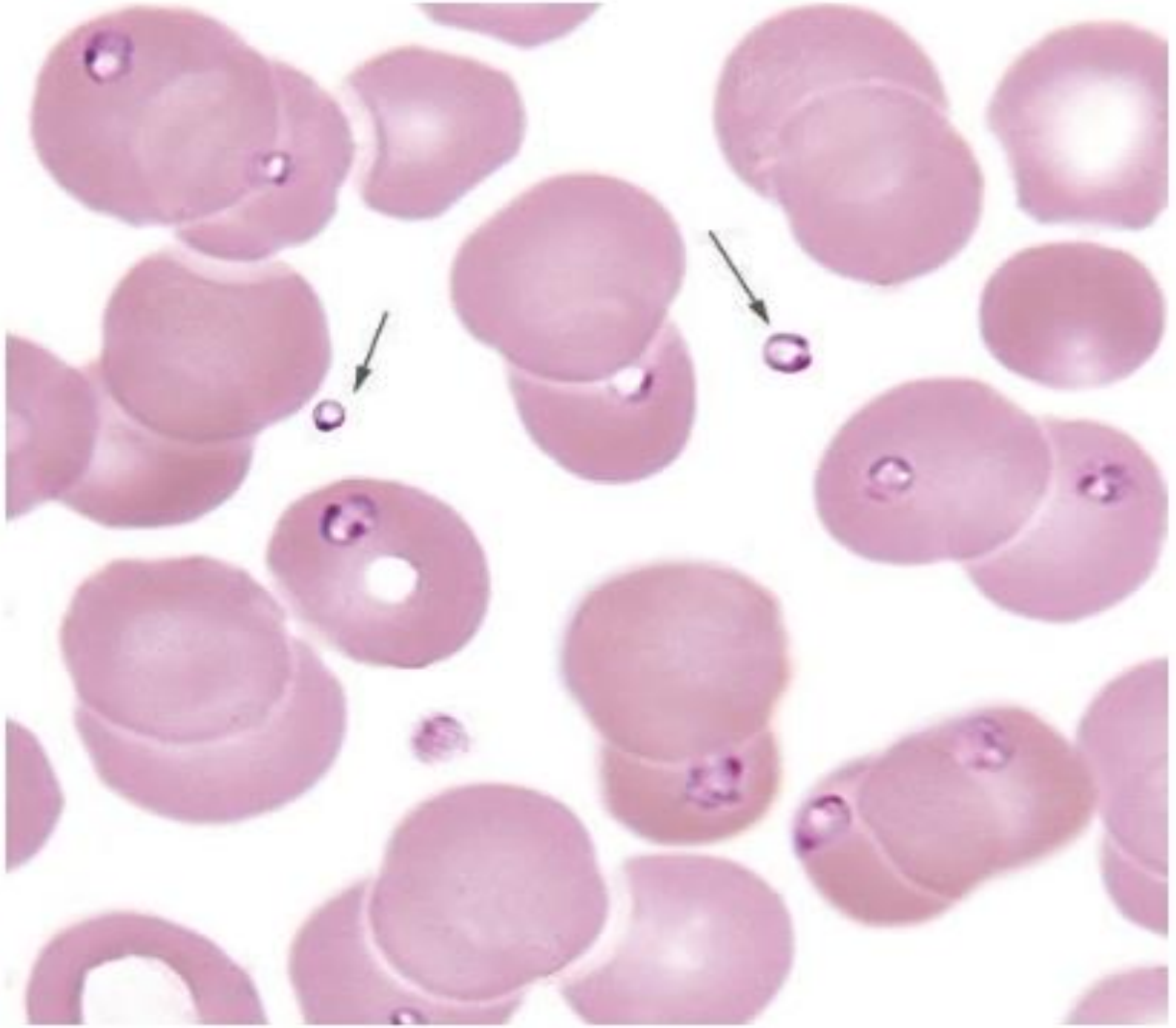
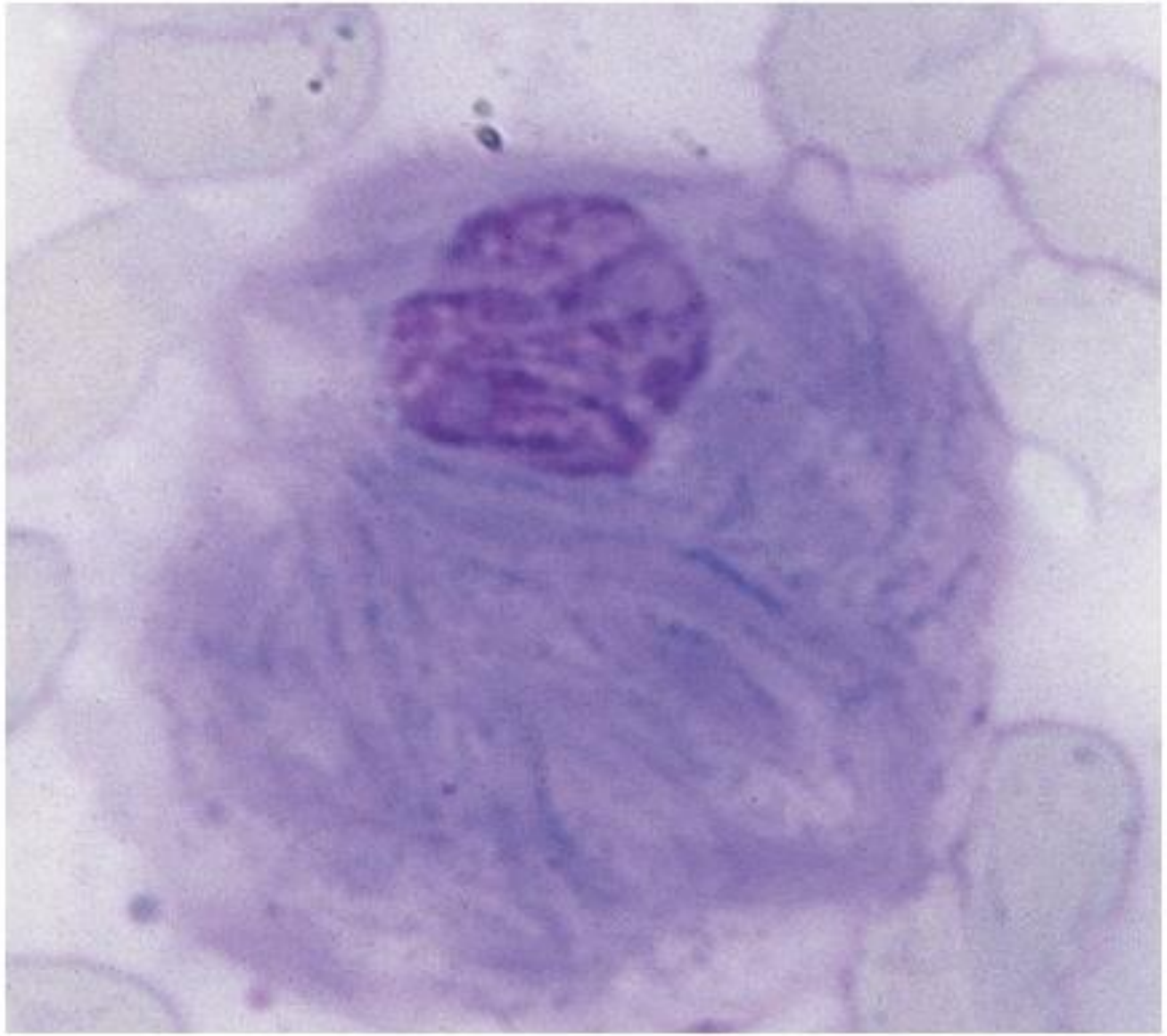
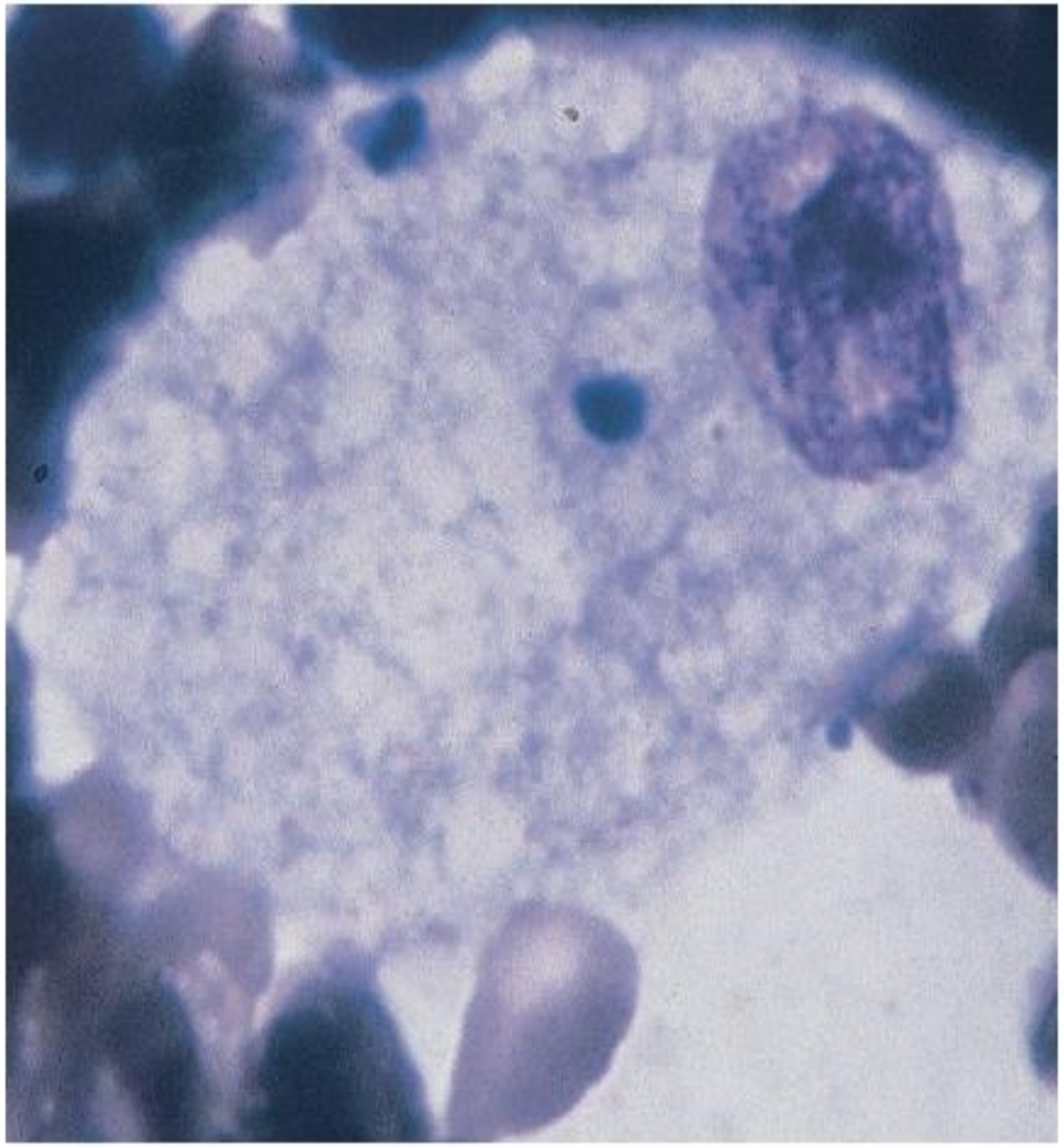


FIGURE 21–2 *Babesia microti* (PB ×1000).



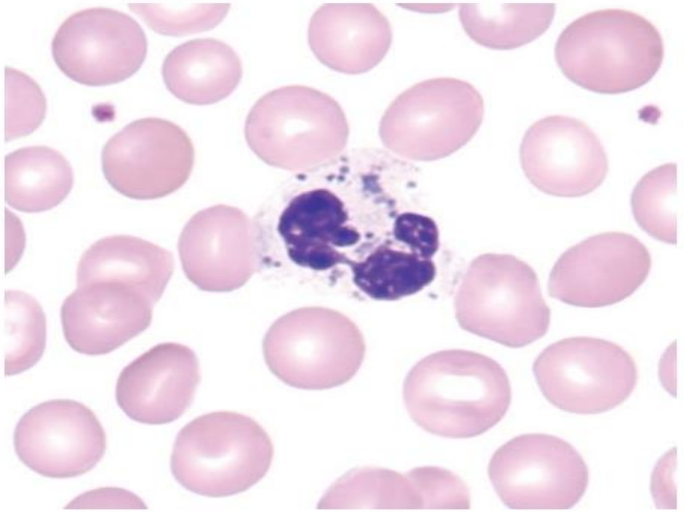
A

FIGURE 22-1A Gaucher cell (BM ×1000).



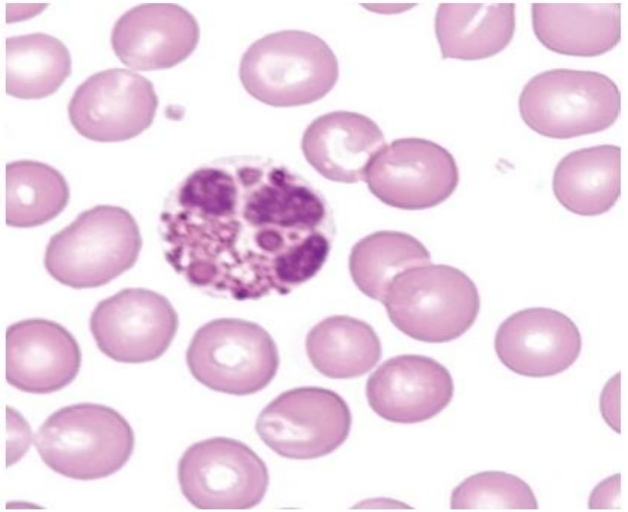
B

FIGURE 22-1B Niemann-Pick disease (BM ×1000).



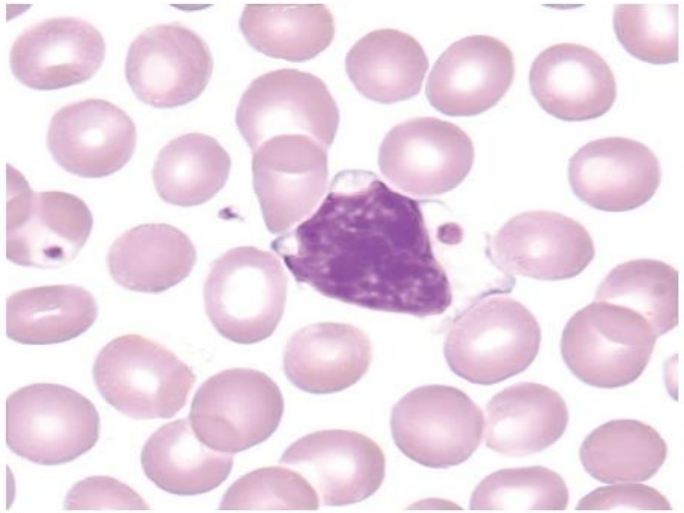
F

FIGURE 22–1F Chédiak-Higashi anomaly neutrophil with granules (PB ×1000).



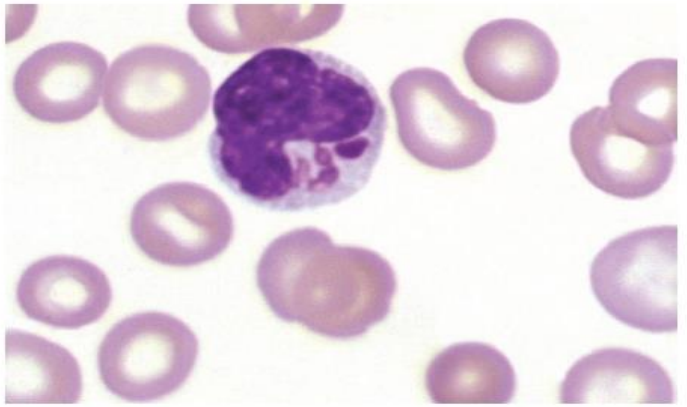
G

FIGURE 22–1G Chédiak-Higashi anomaly eosinophil with granules (PB ×1000).



H

FIGURE 22–1H Chédiak-Higashi anomaly lymphocyte with granule (PB ×1000).

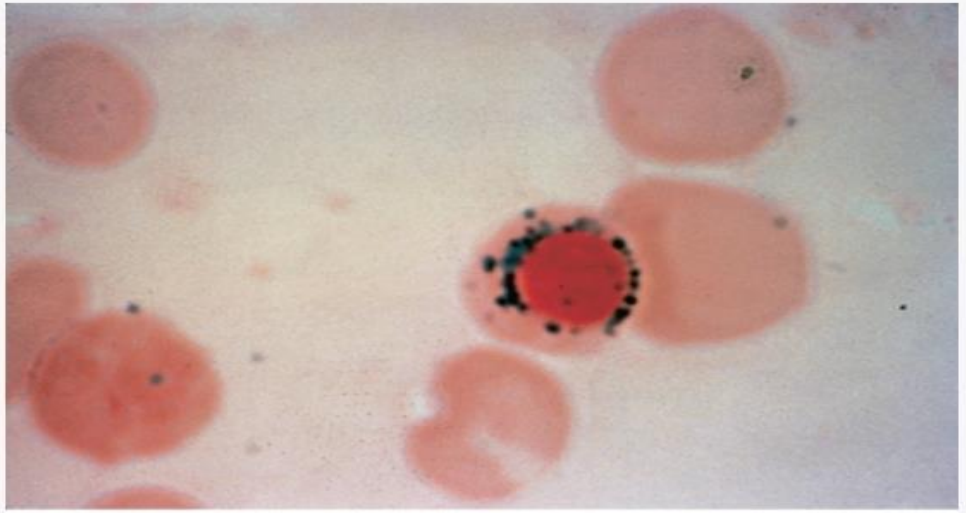


I

FIGURE 22–1I Chédiak-Higashi anomaly monocyte with granules (PB ×1000).

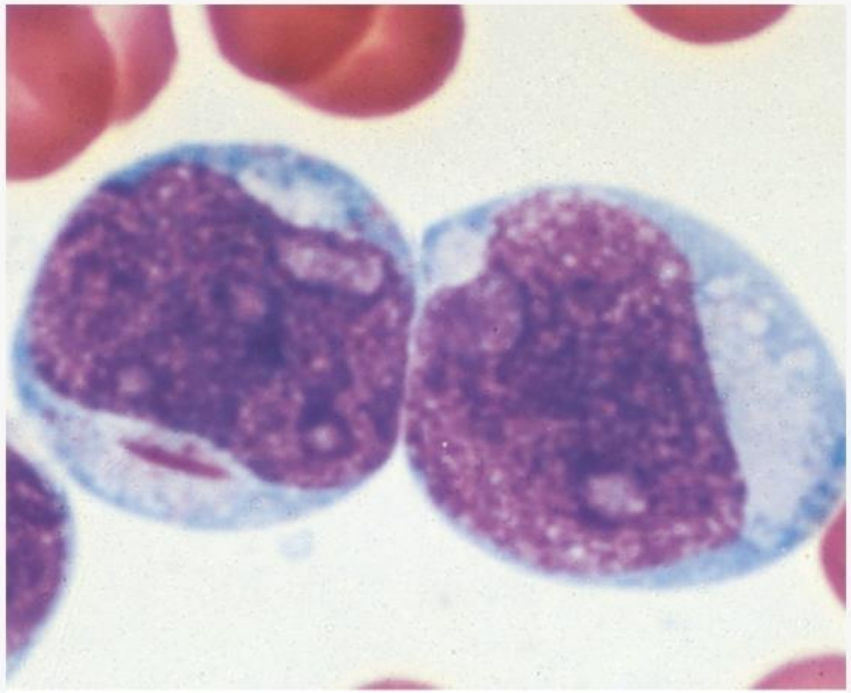
DESCRIPTION: Large gray-blue granules in the cytoplasm of many granulocytes. Monocytes, lymphocytes, and eosinophils may contain large red-purple granules.

Ringed sideroblast. An orthochromatic normoblast with a collar of blue granules (mitochondria encrusted with iron) surrounding the nucleus.

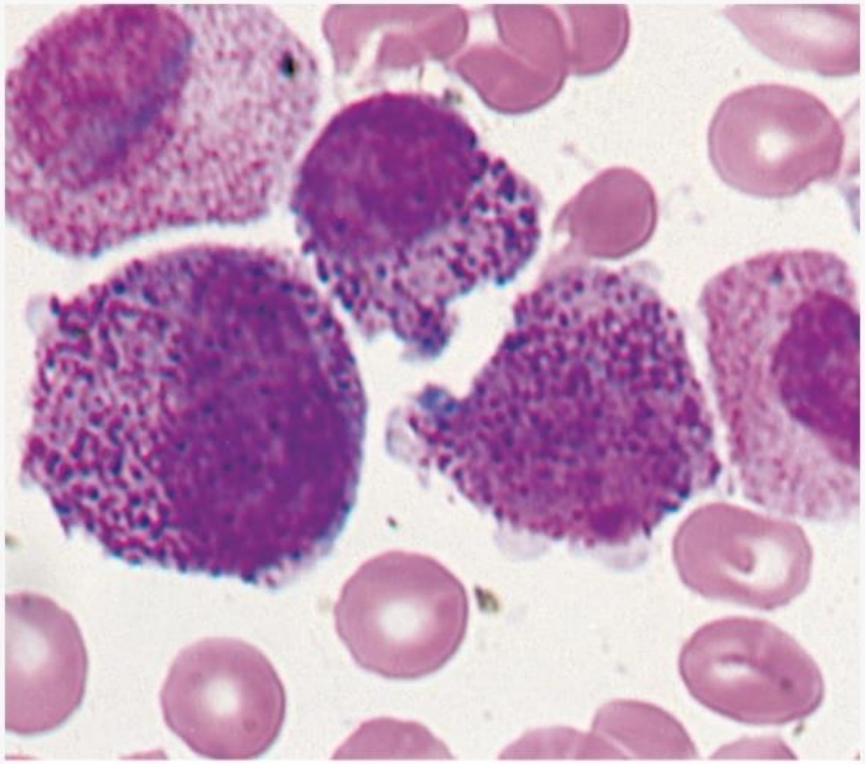


Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition

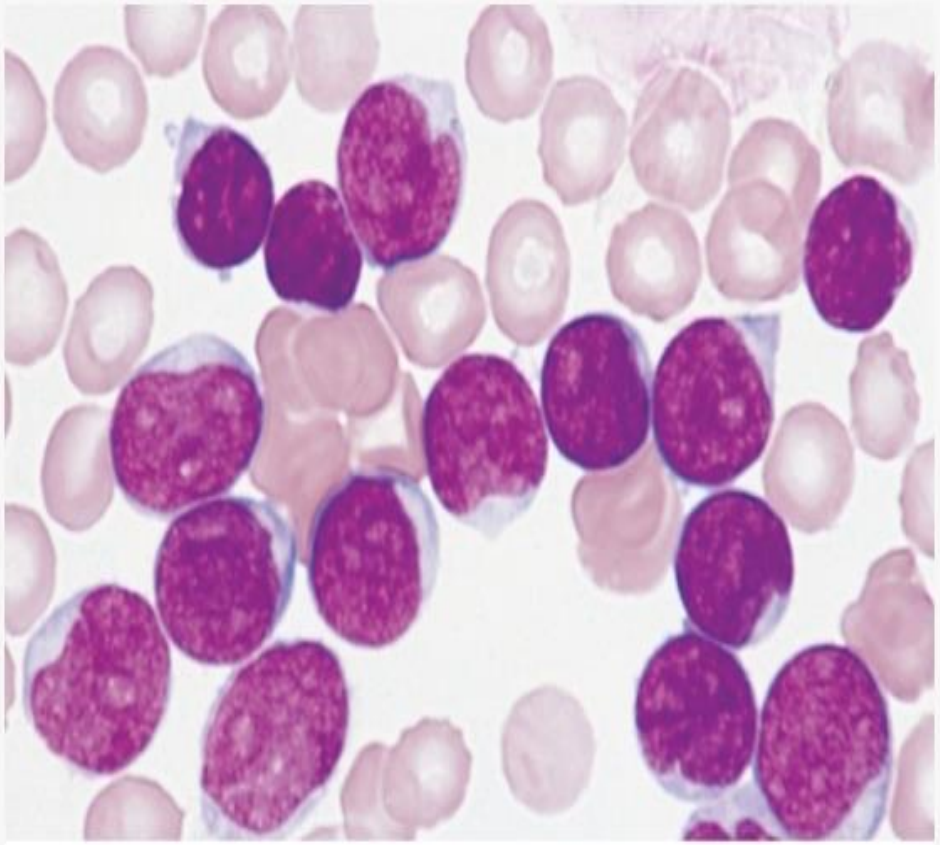
Acute myeloid leukemia. Leukemic myeloblast with an Auer rod. Note two to four large, prominent nucleoli in each cell.



Acute promyelocytic leukemia. Note prominent cytoplasmic granules in the leukemia cells.

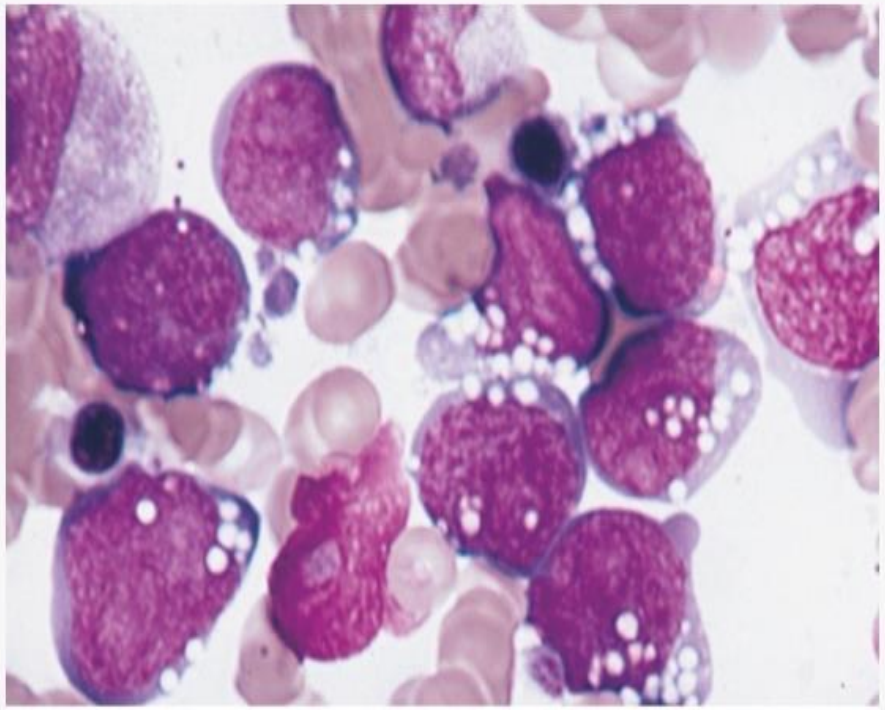


Acute lymphoblastic leukemia.



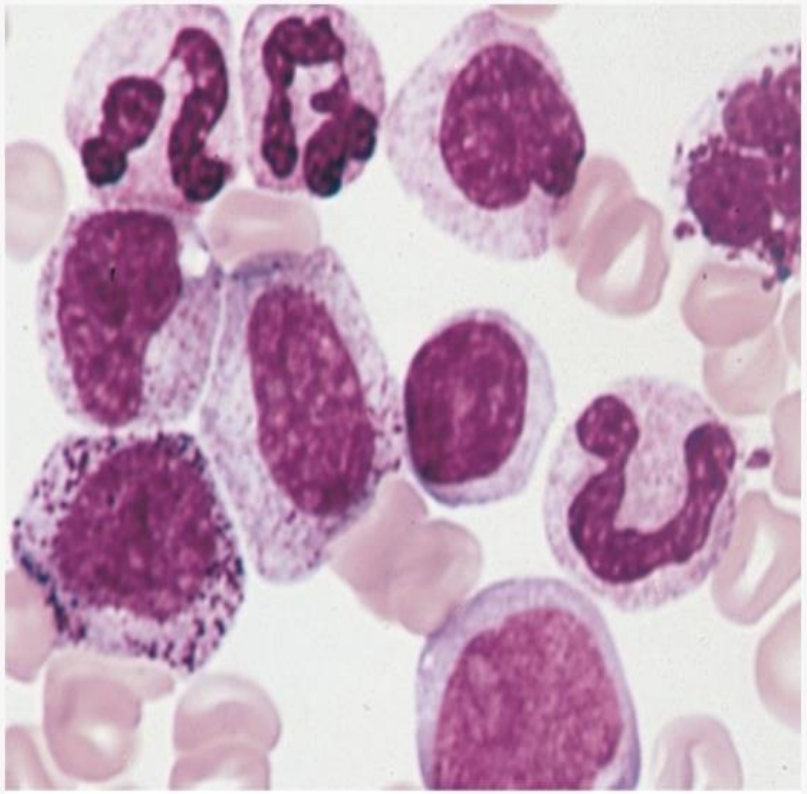
Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition

Burkitt's leukemia, acute lymphoblastic leukemia.



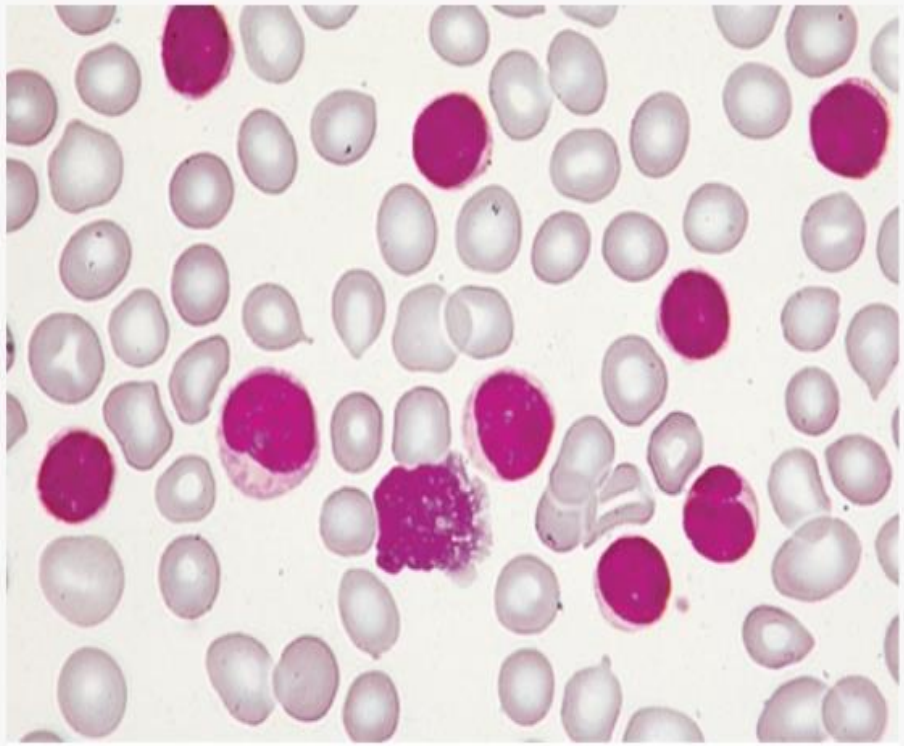
Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition

Chronic myeloid leukemia in the peripheral blood.



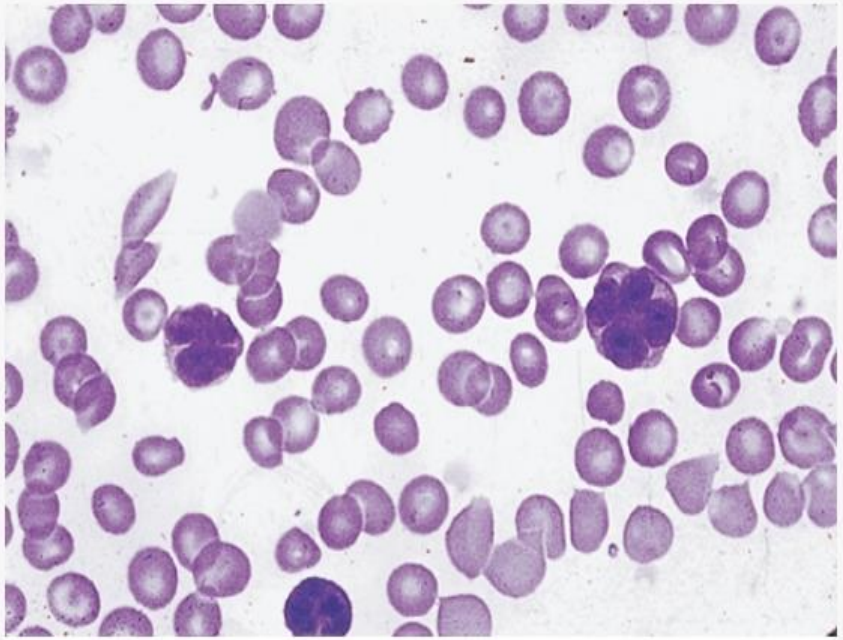
Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition

Chronic lymphoid leukemia in the peripheral blood.



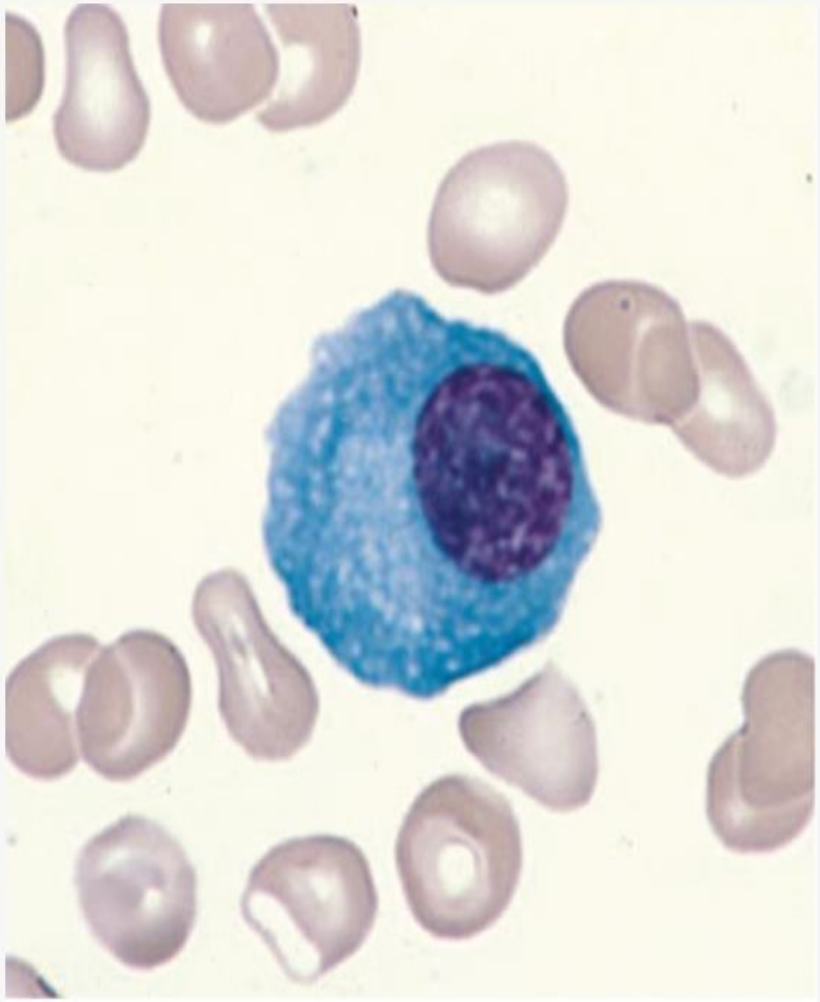
Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition

Adult T cell leukemia. Peripheral blood smear showing leukemia cells with typical “flower-shaped” nucleus.



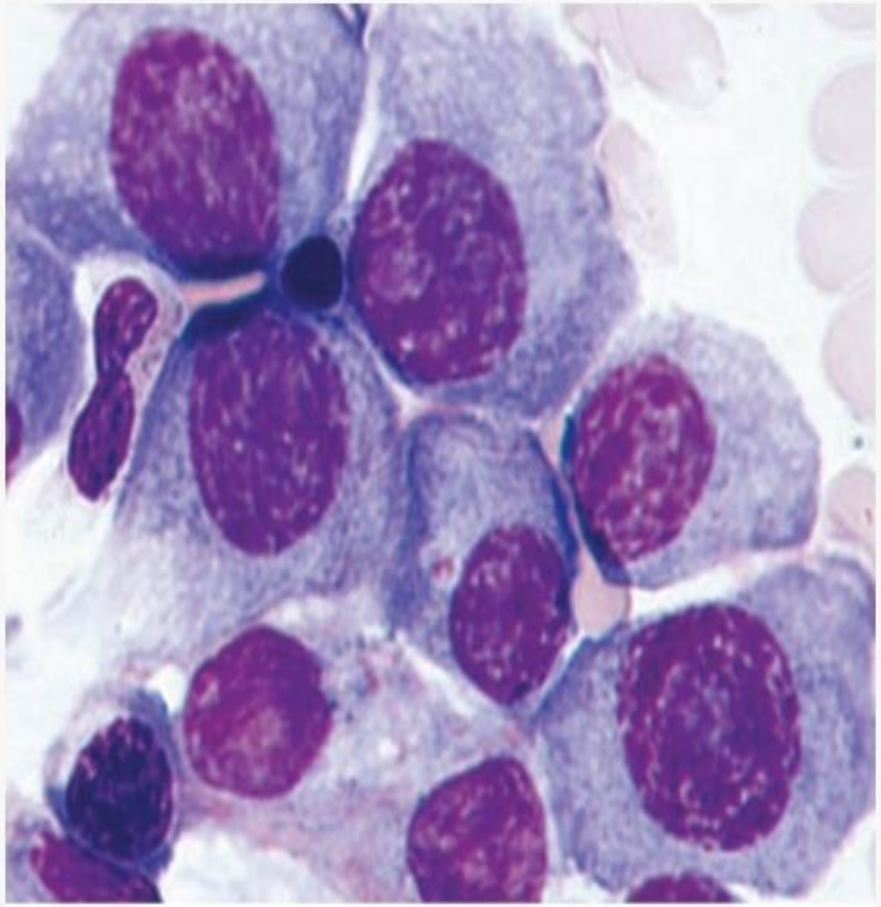
Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition

Normal plasma cell.



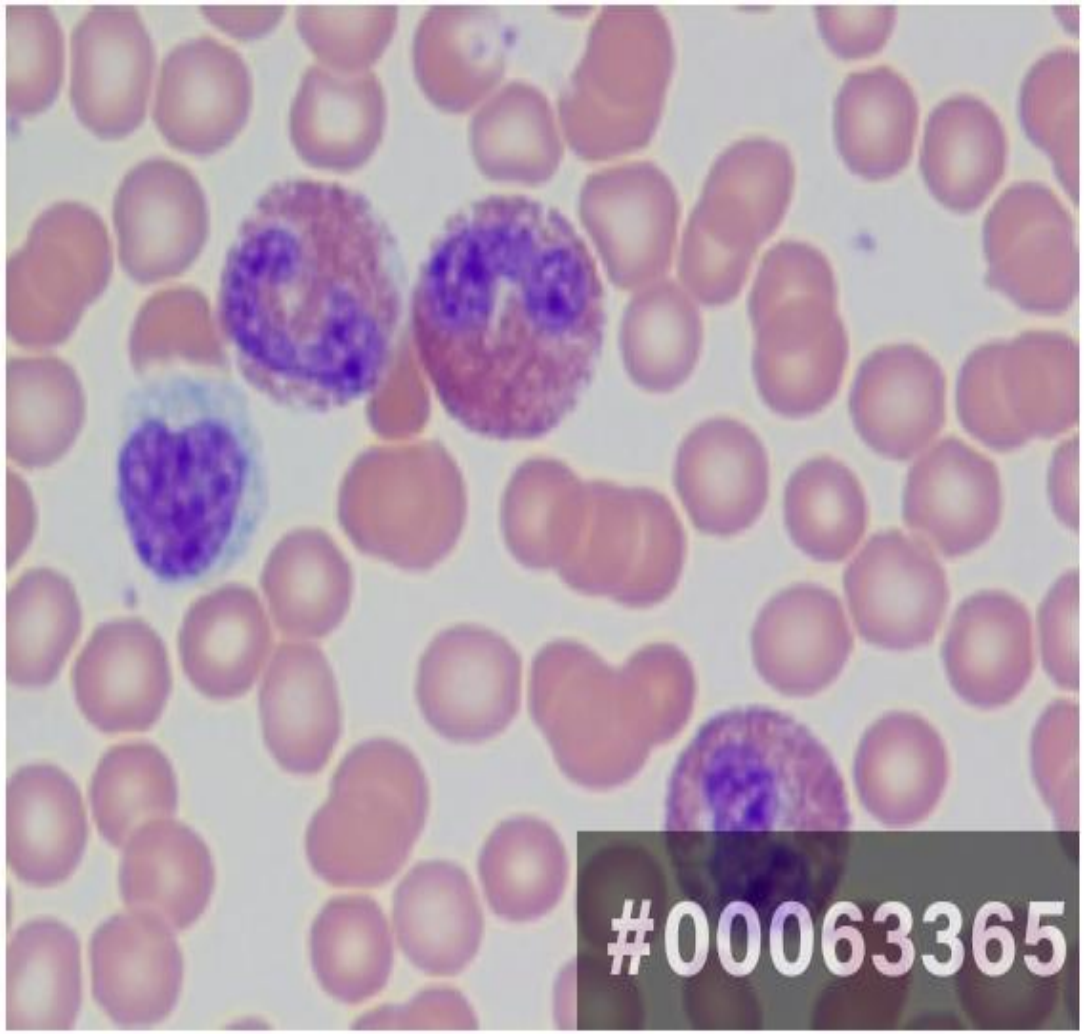
Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition

Multiple myeloma.

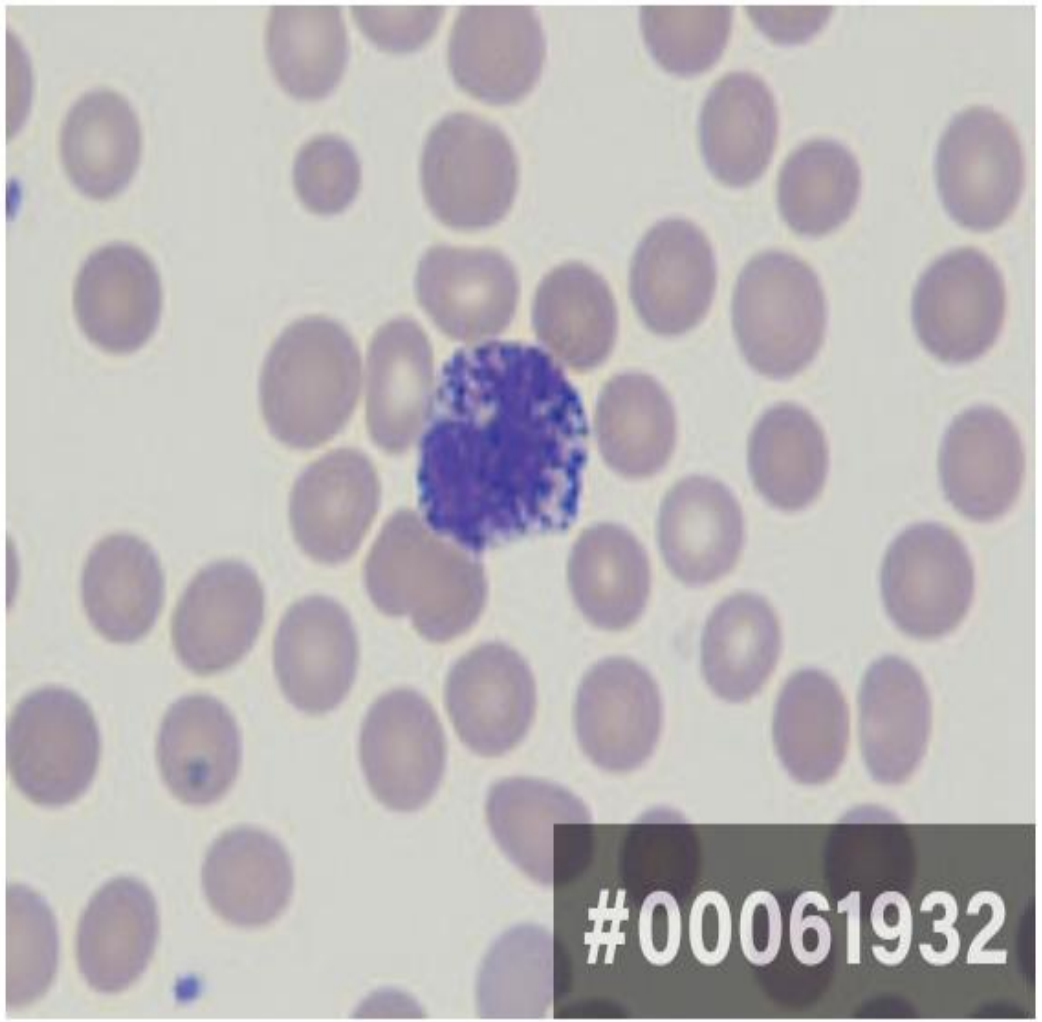


Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition

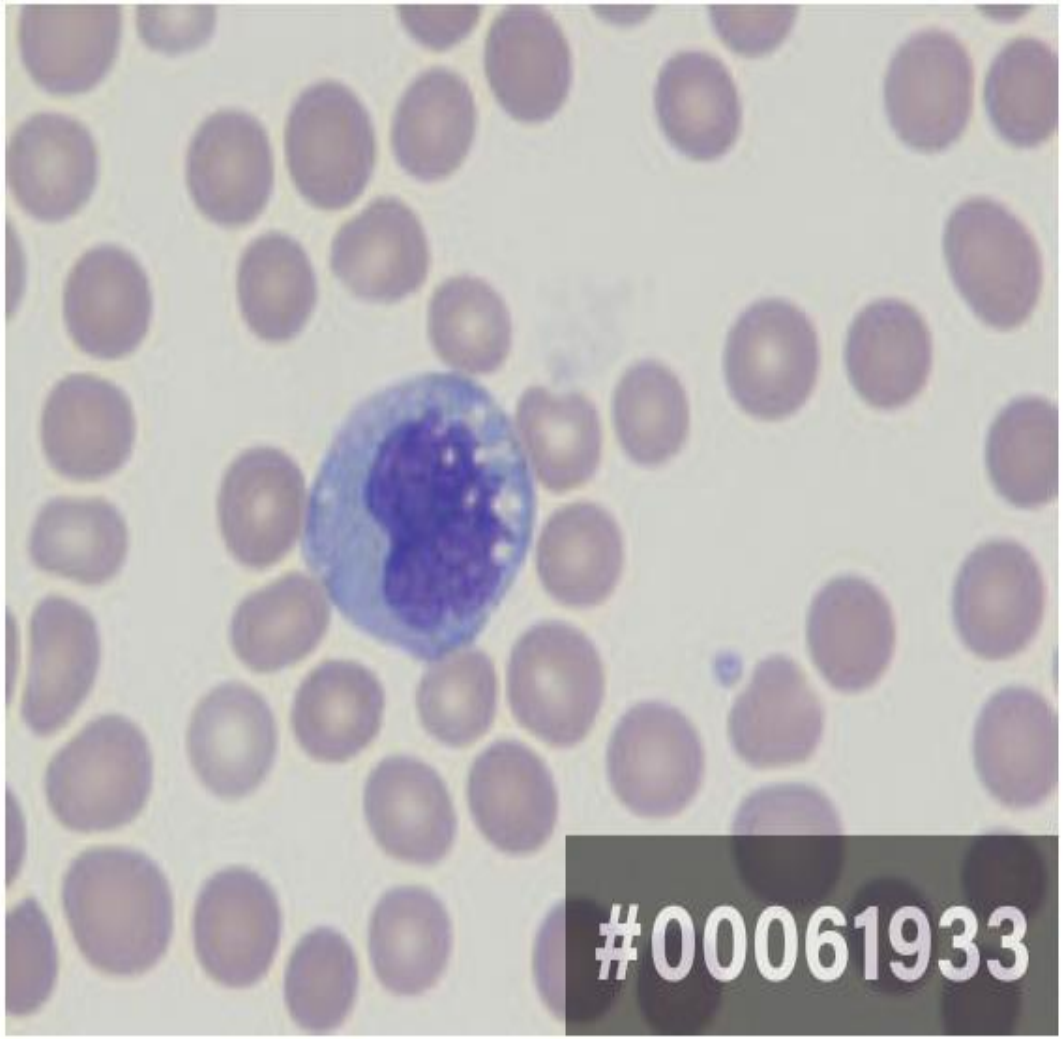
Color serum in hemoglobinemia. The distinctive red coloration of plasma (hemoglobinemia) in a spun blood sample in a patient with intravascular hemolysis.



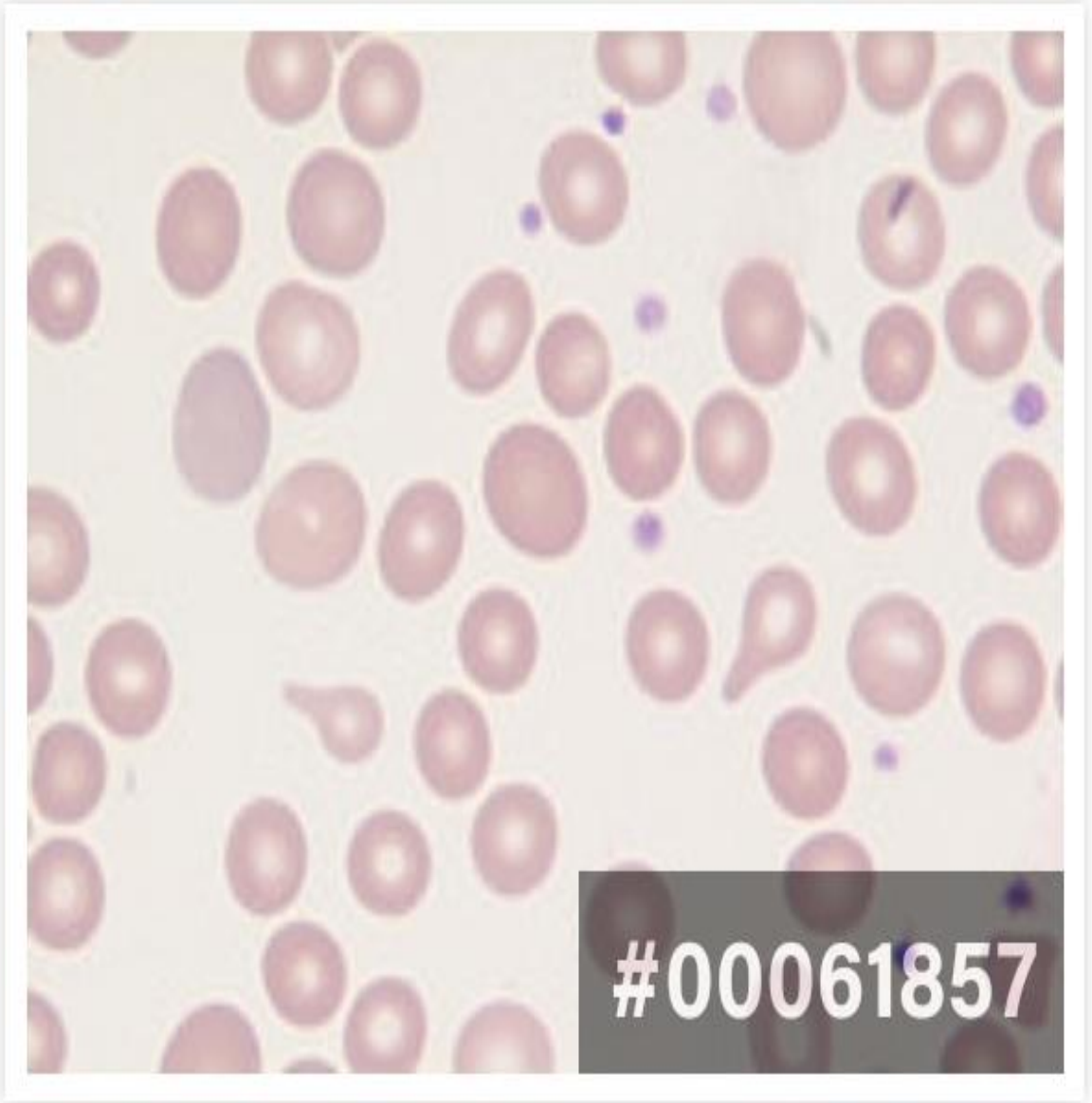
Eosinophils and lymphocyte



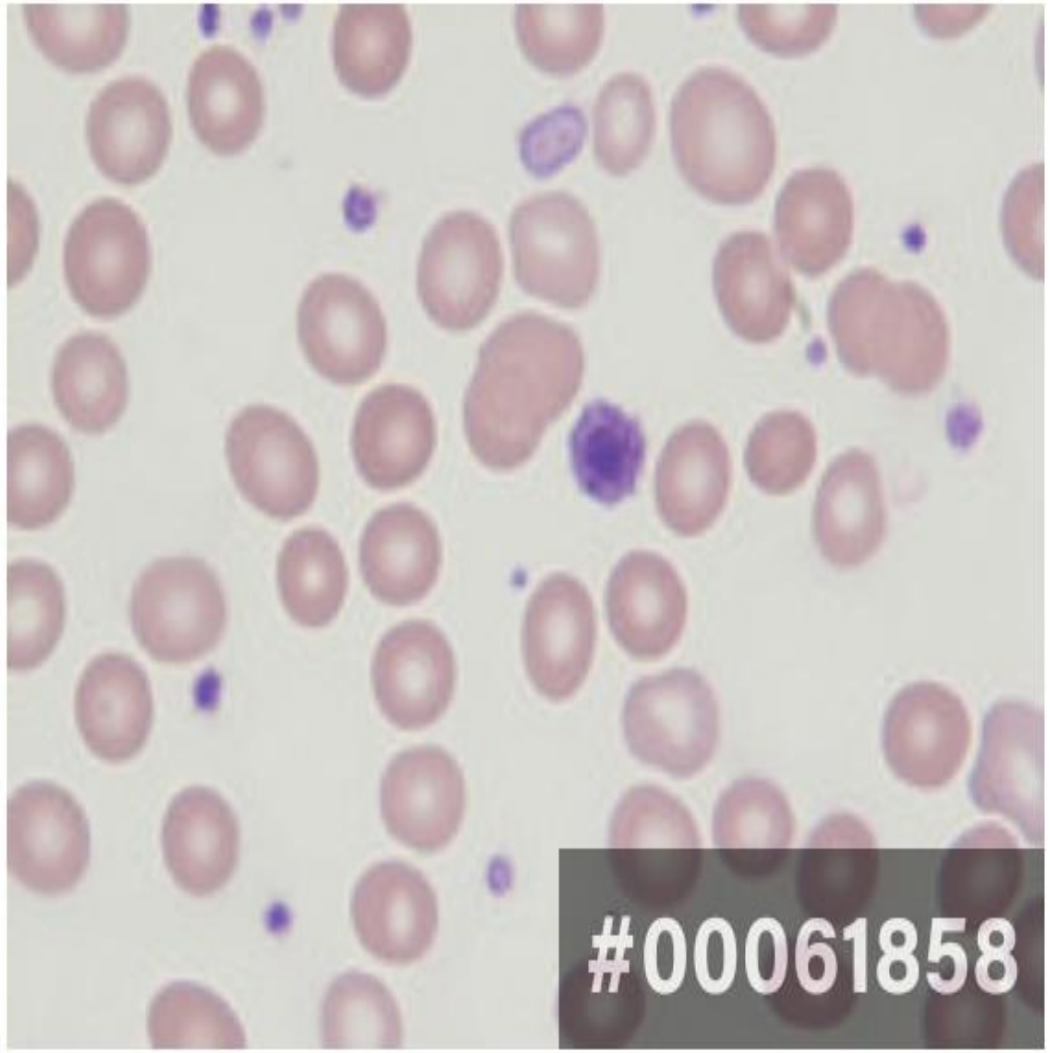
Basophil



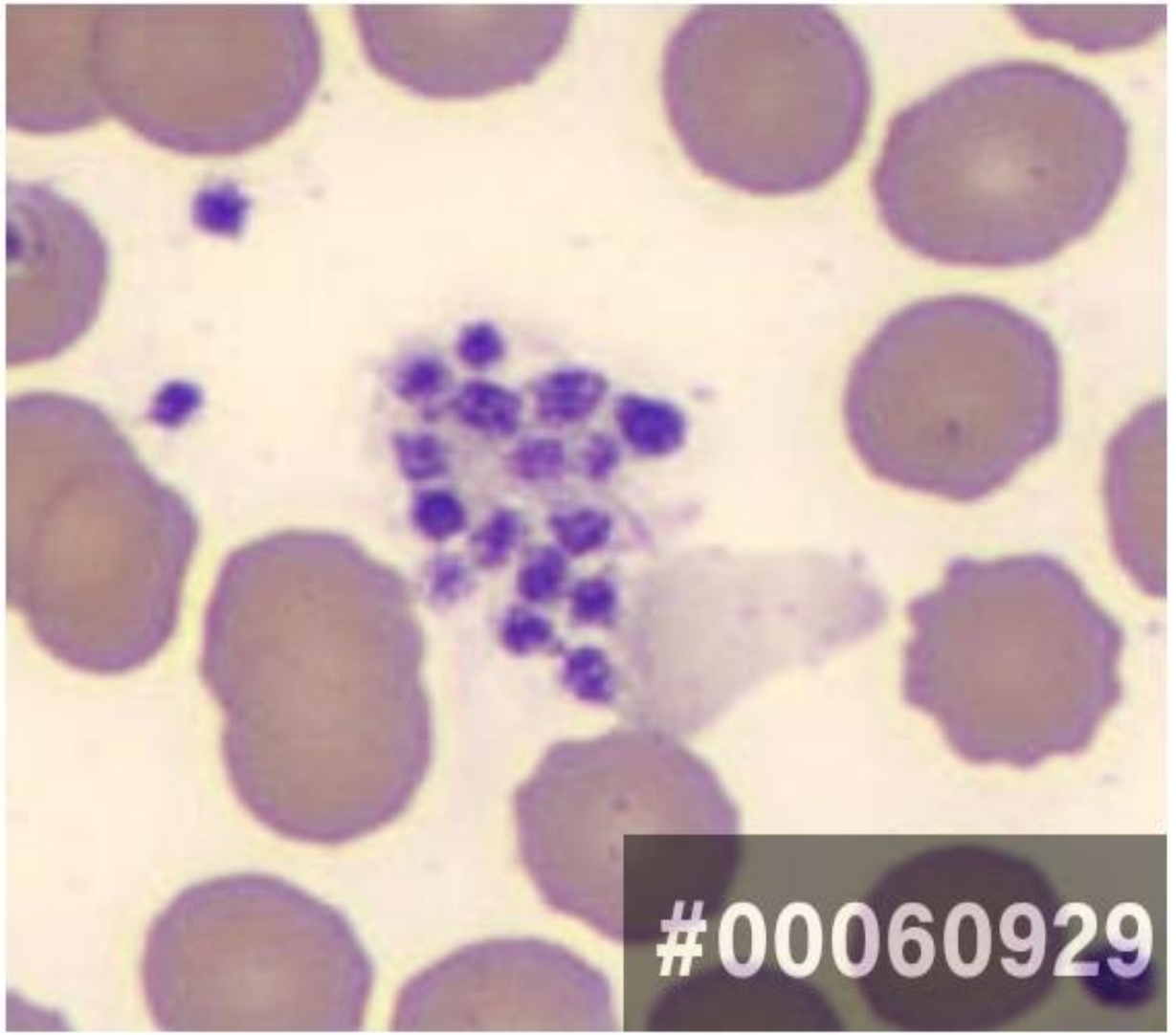
Monocyte



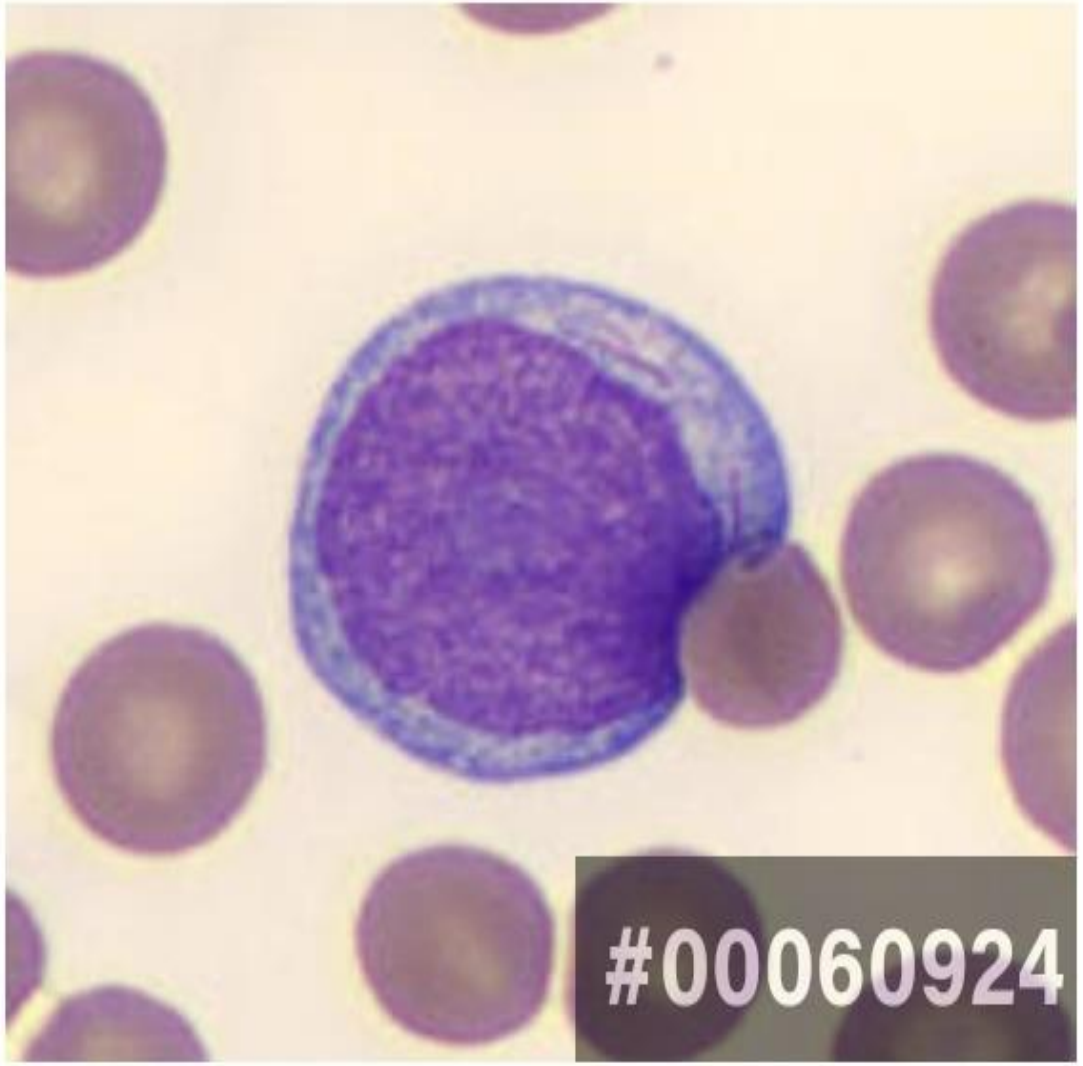
Blood-Tear Drop cells



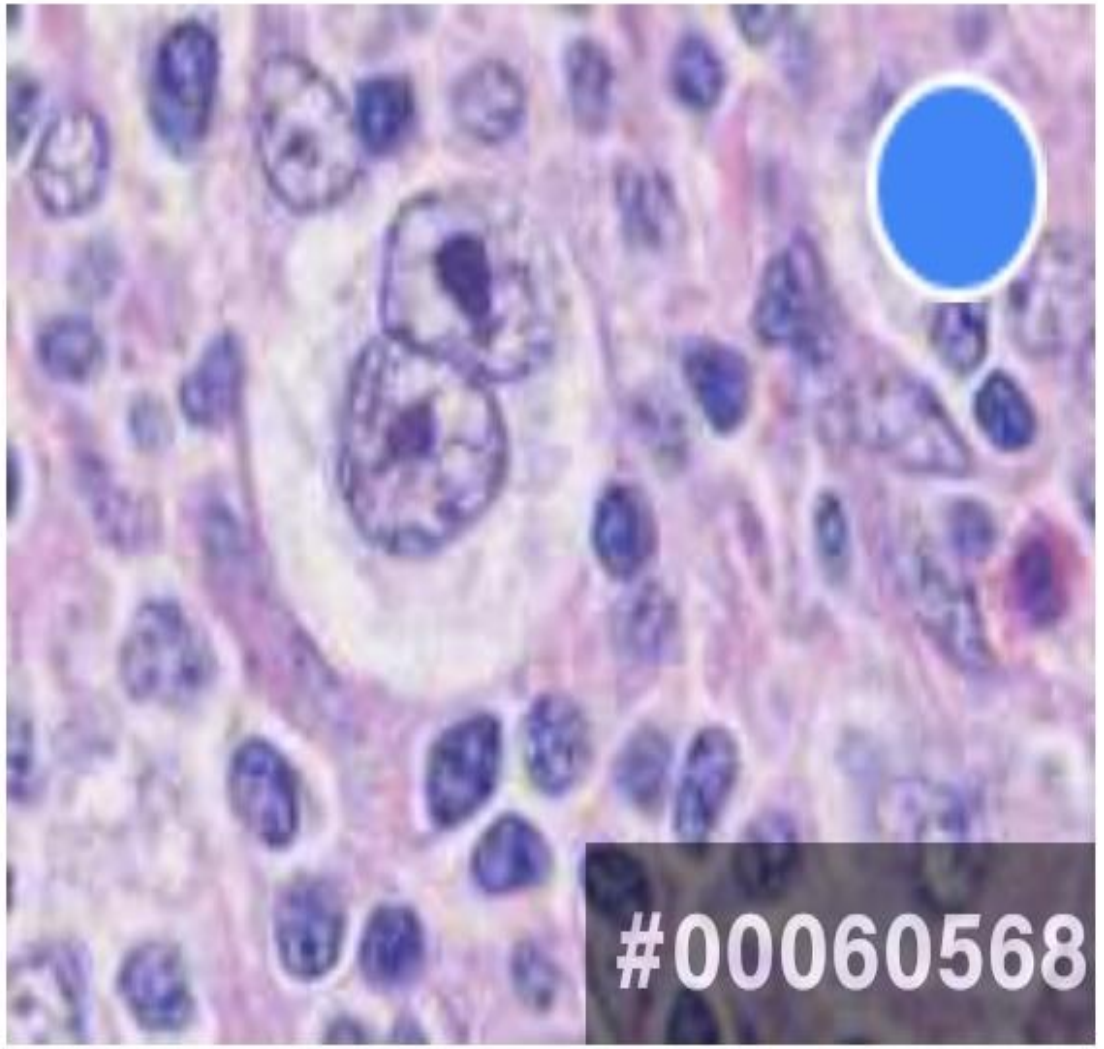
Blood-giant platelet



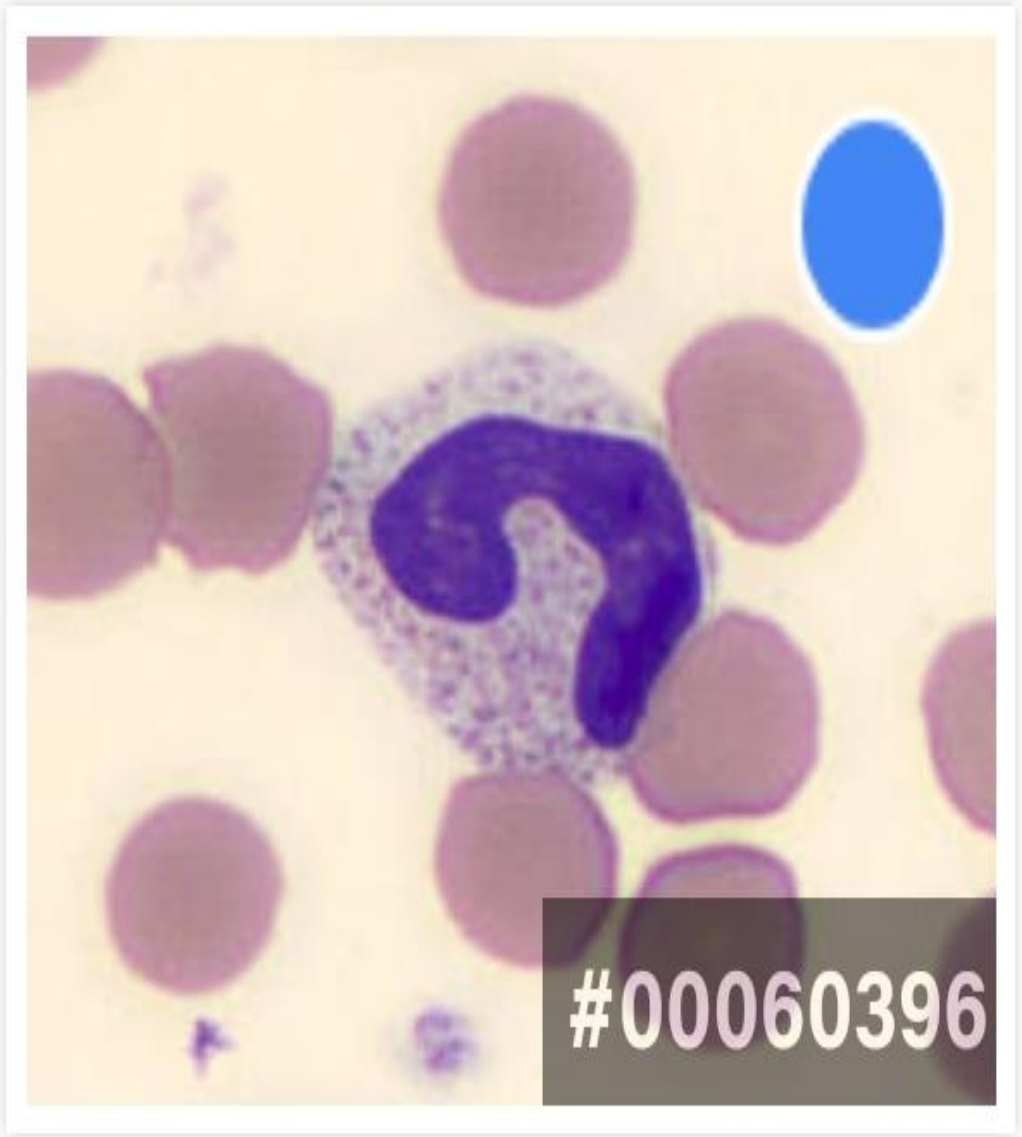
Platelet clump



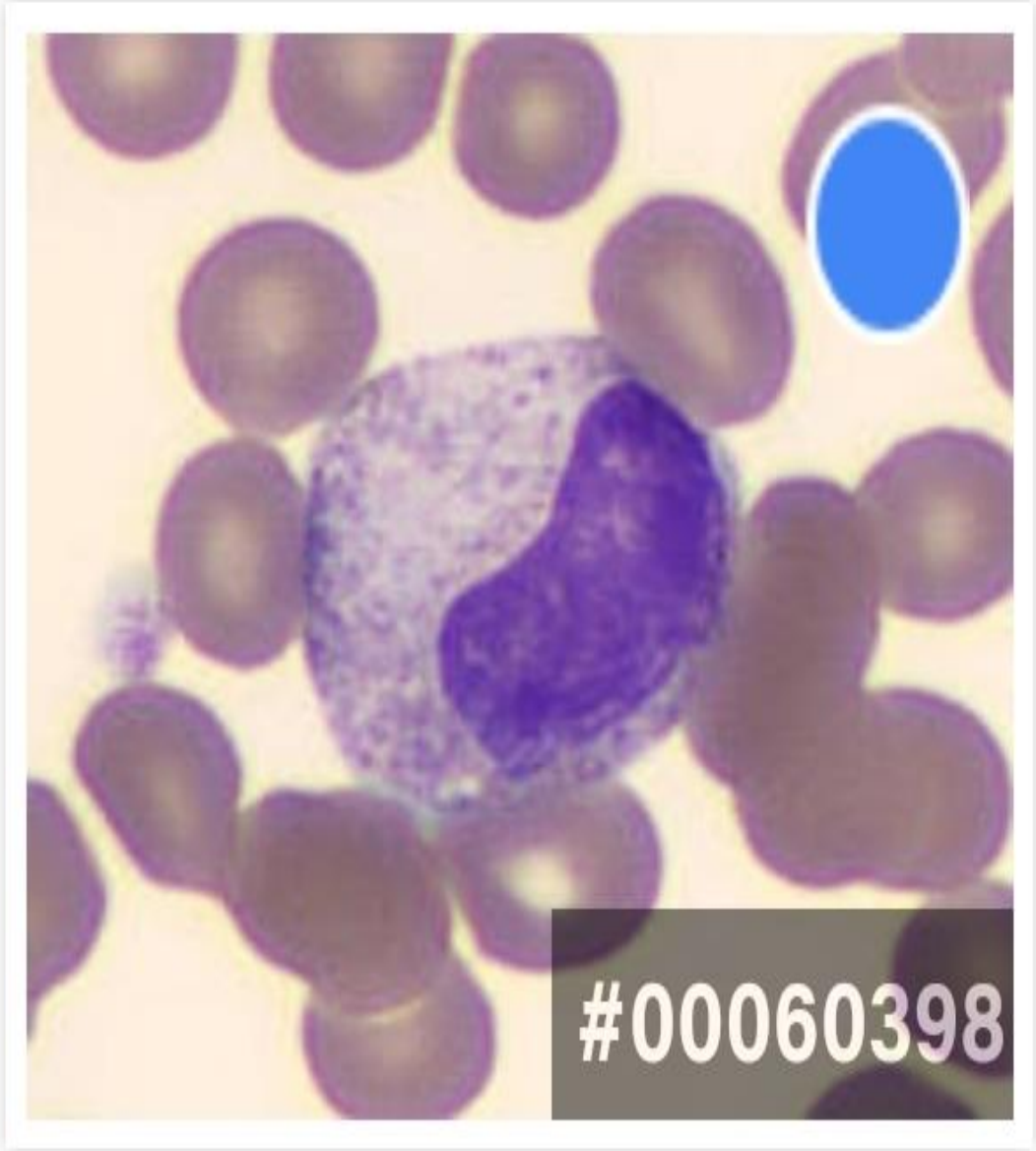
Myeloblast with Auer rod



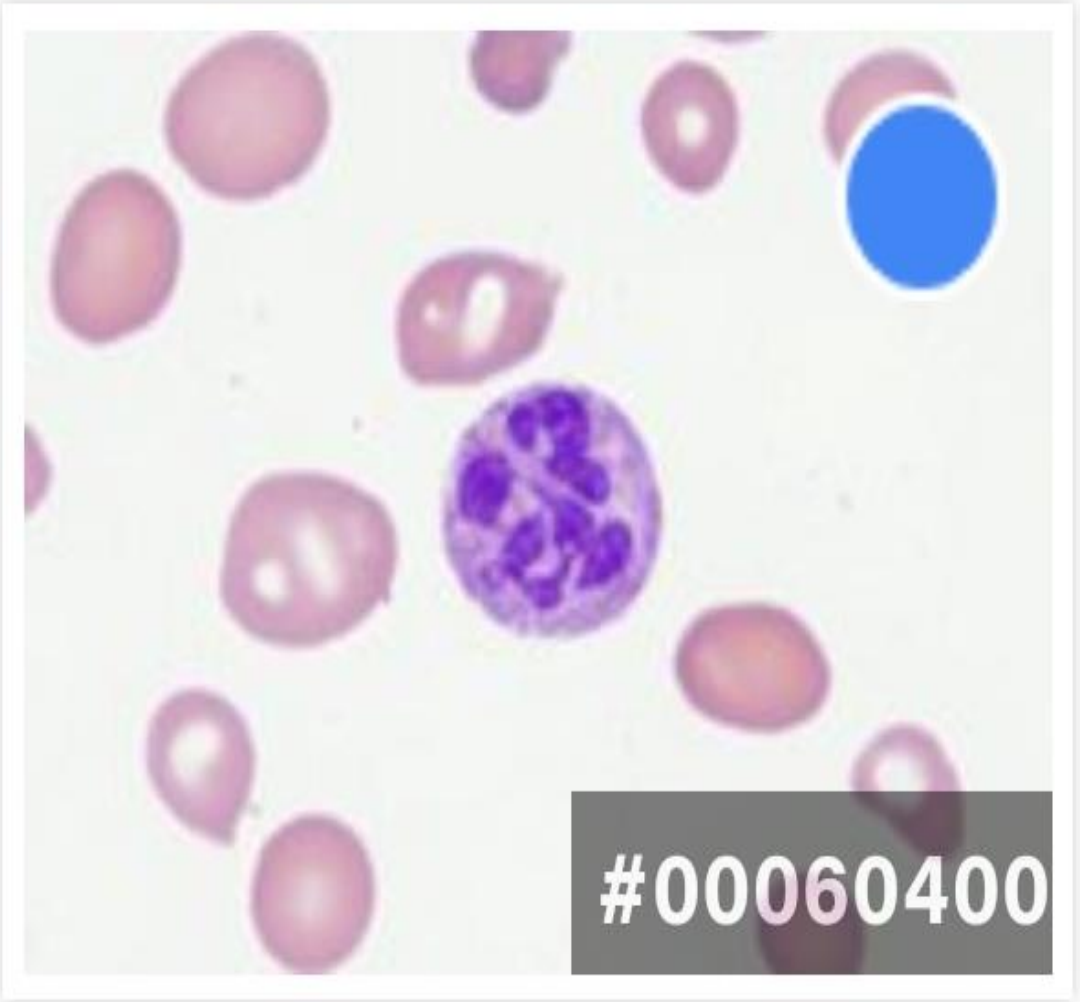
Reed Sternberg Cell



Band neutrophil



Metamyelocyte



Hypersegmented neutrophil

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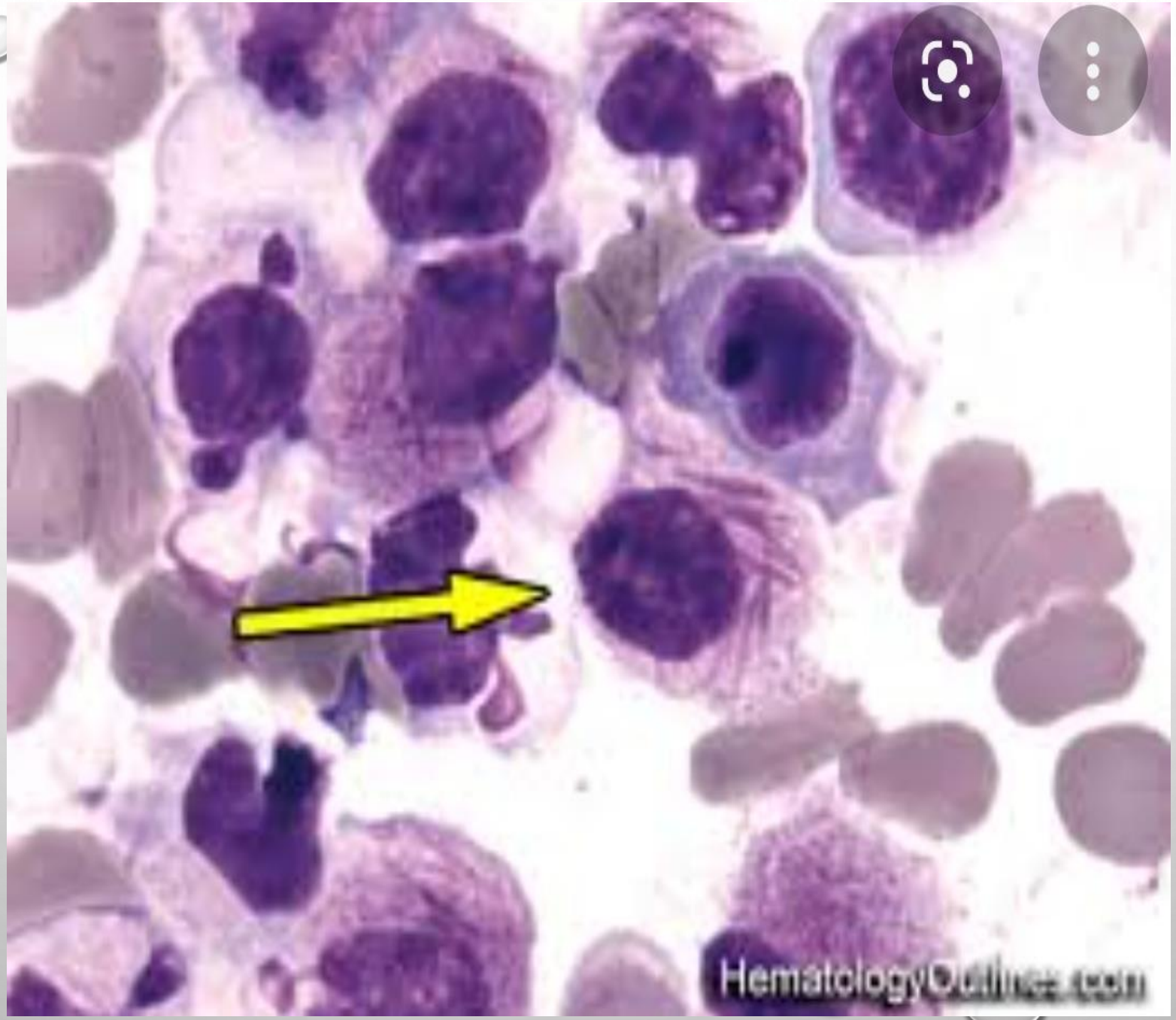
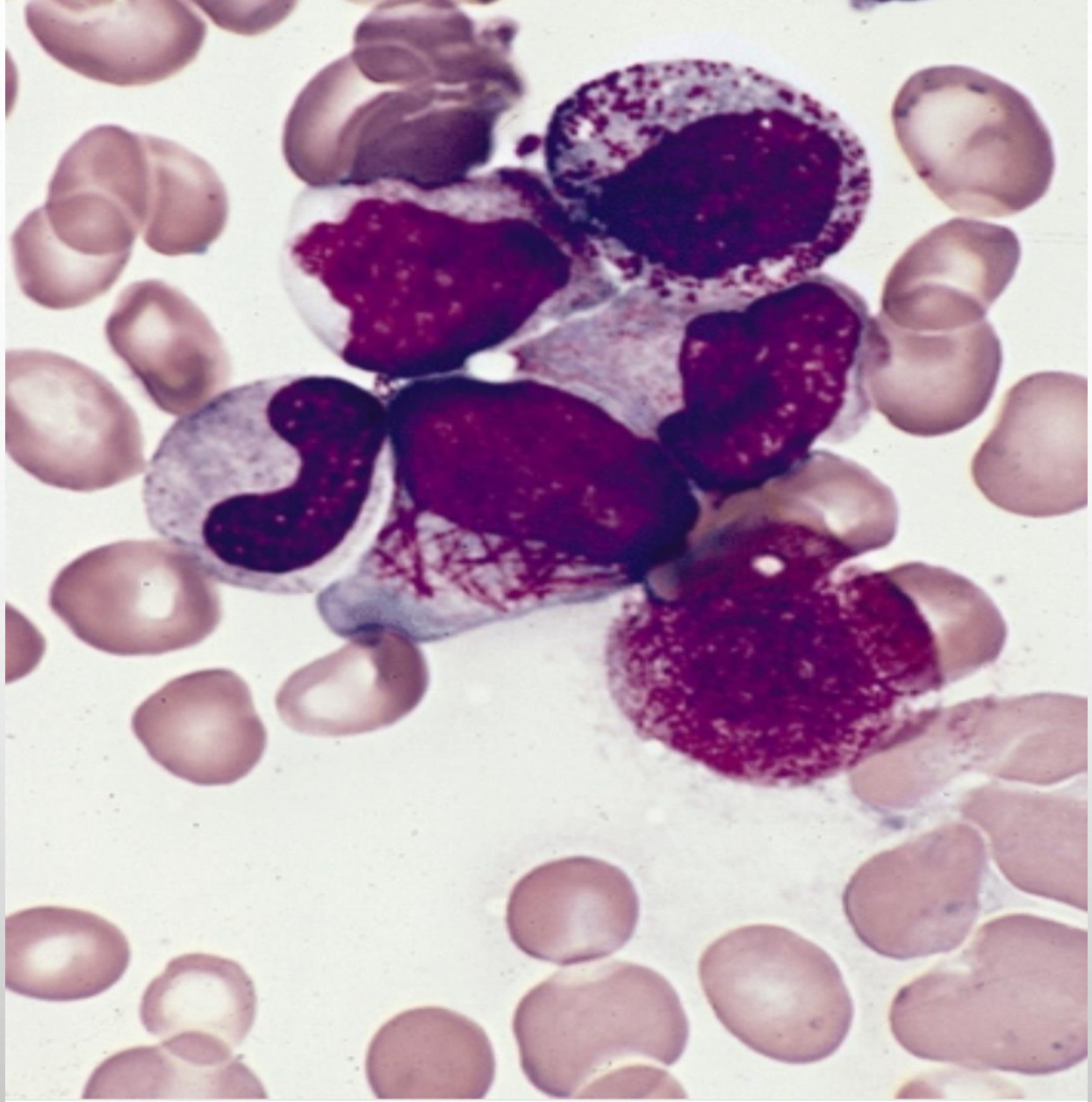
Faggot cell


HematologyOutlines.com



Wikipedia

Faggot cell - Wikipedia

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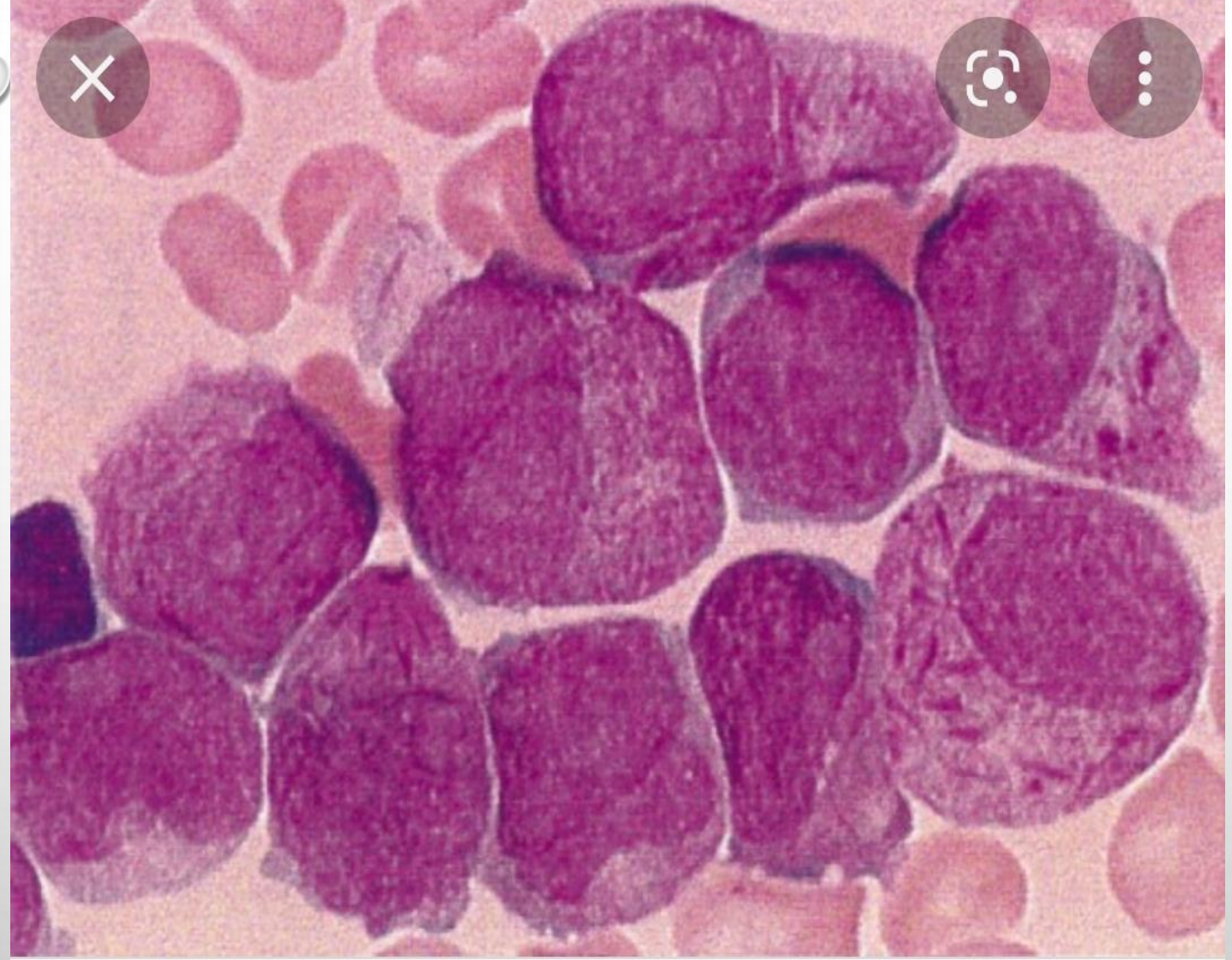

Nature

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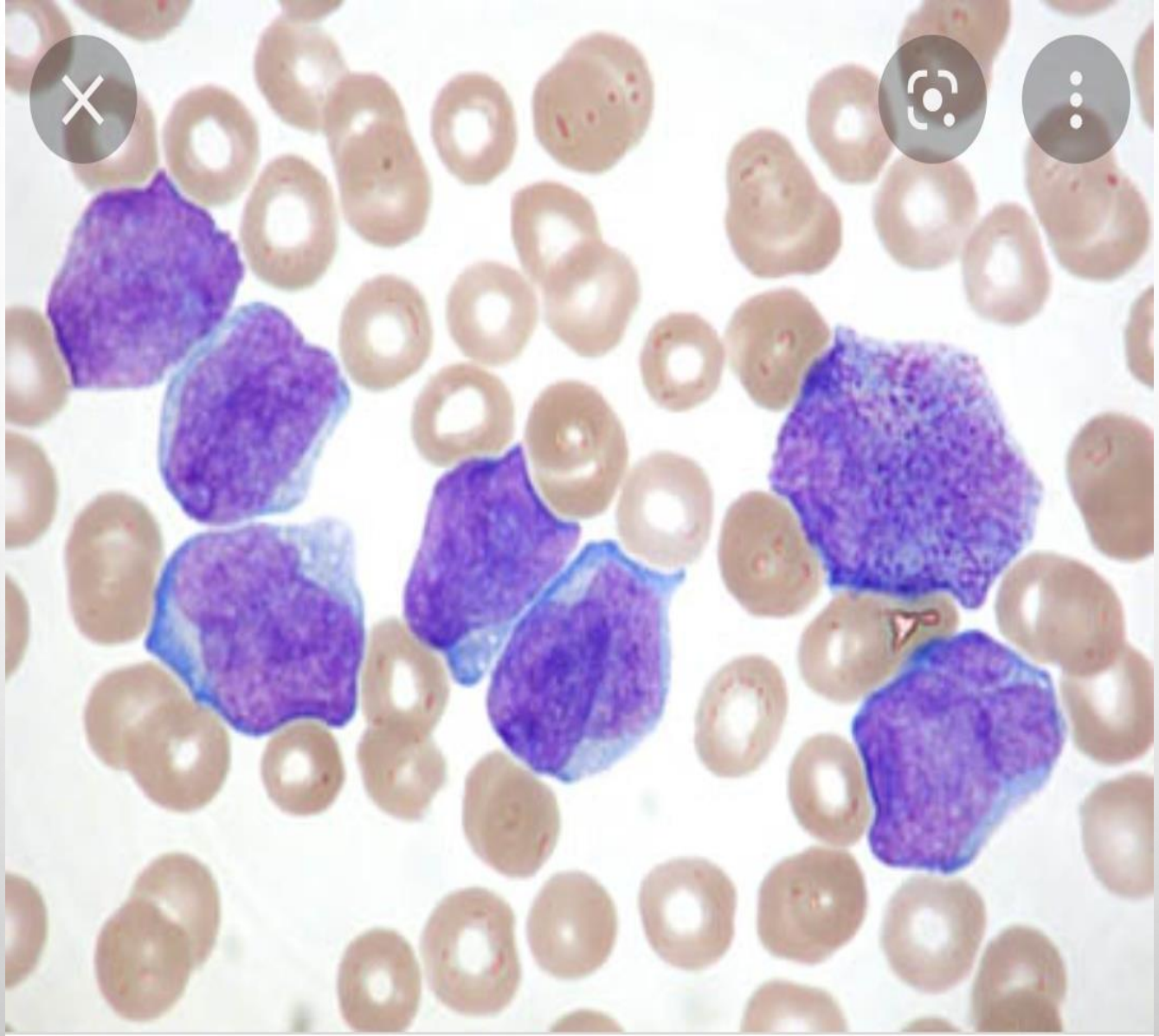
Hypergranular promyelocytic leukemia: correlation between ...



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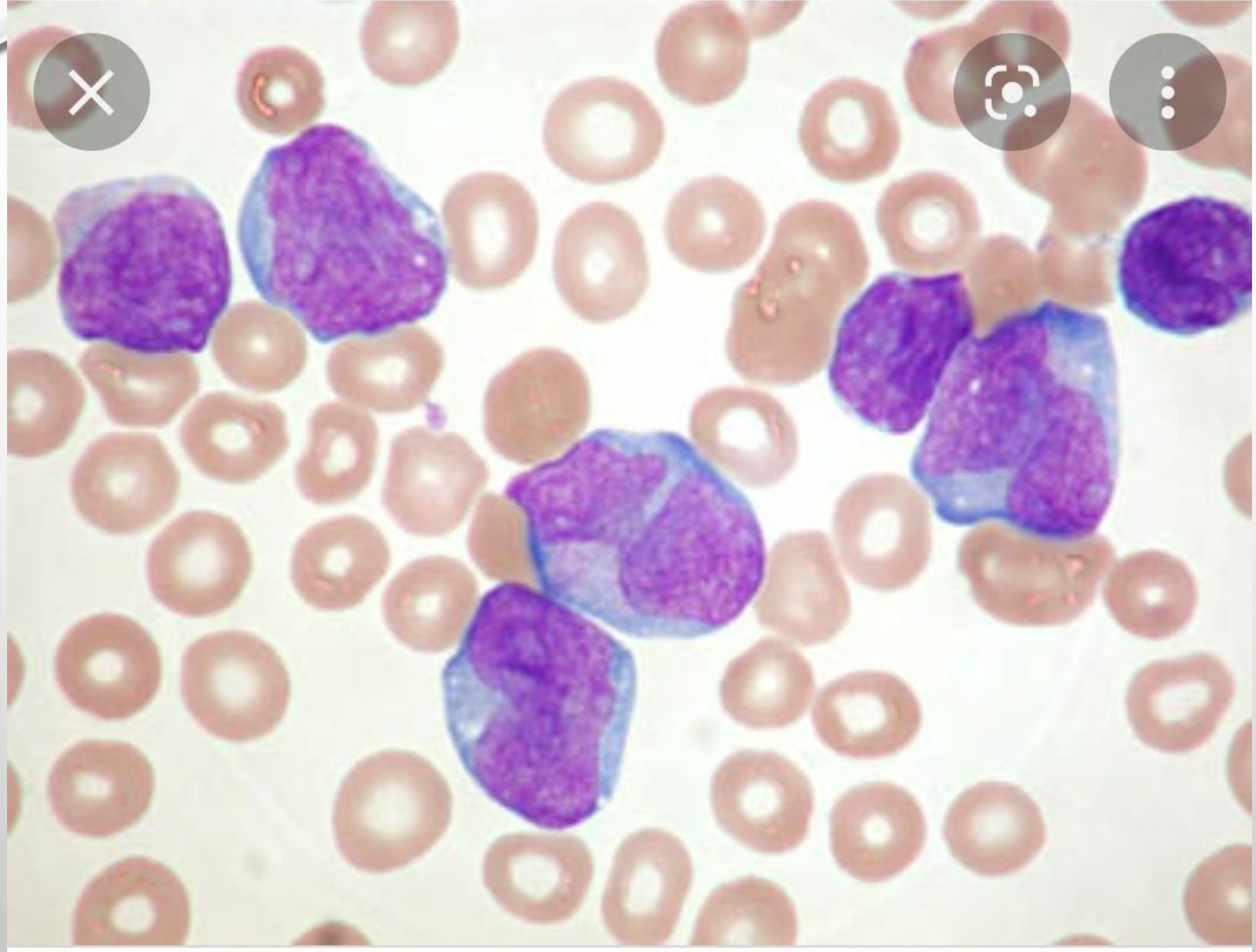
Acute promyelocytic leukaemia or



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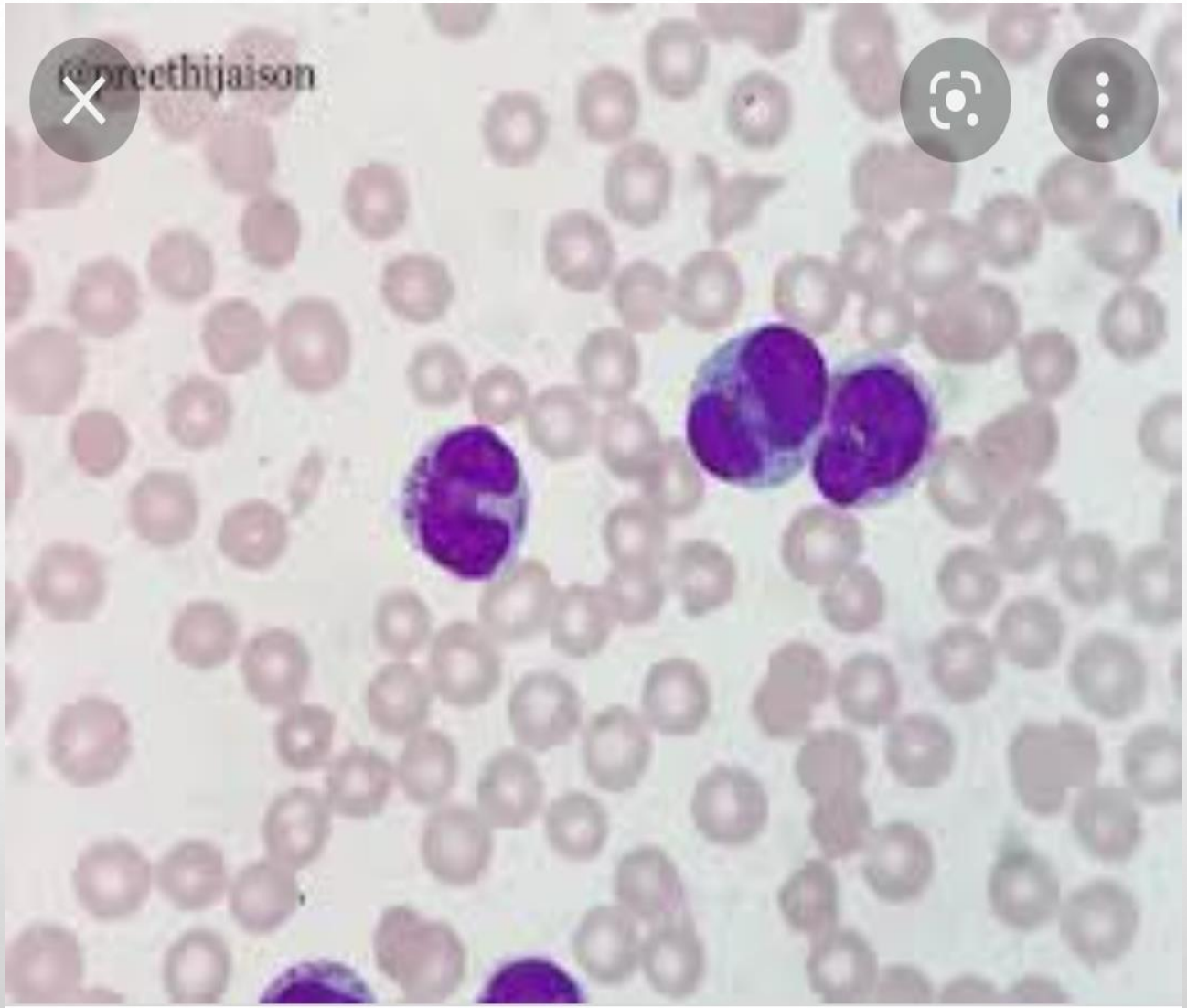
Acute promyelocytic leukaemia or



Twitter

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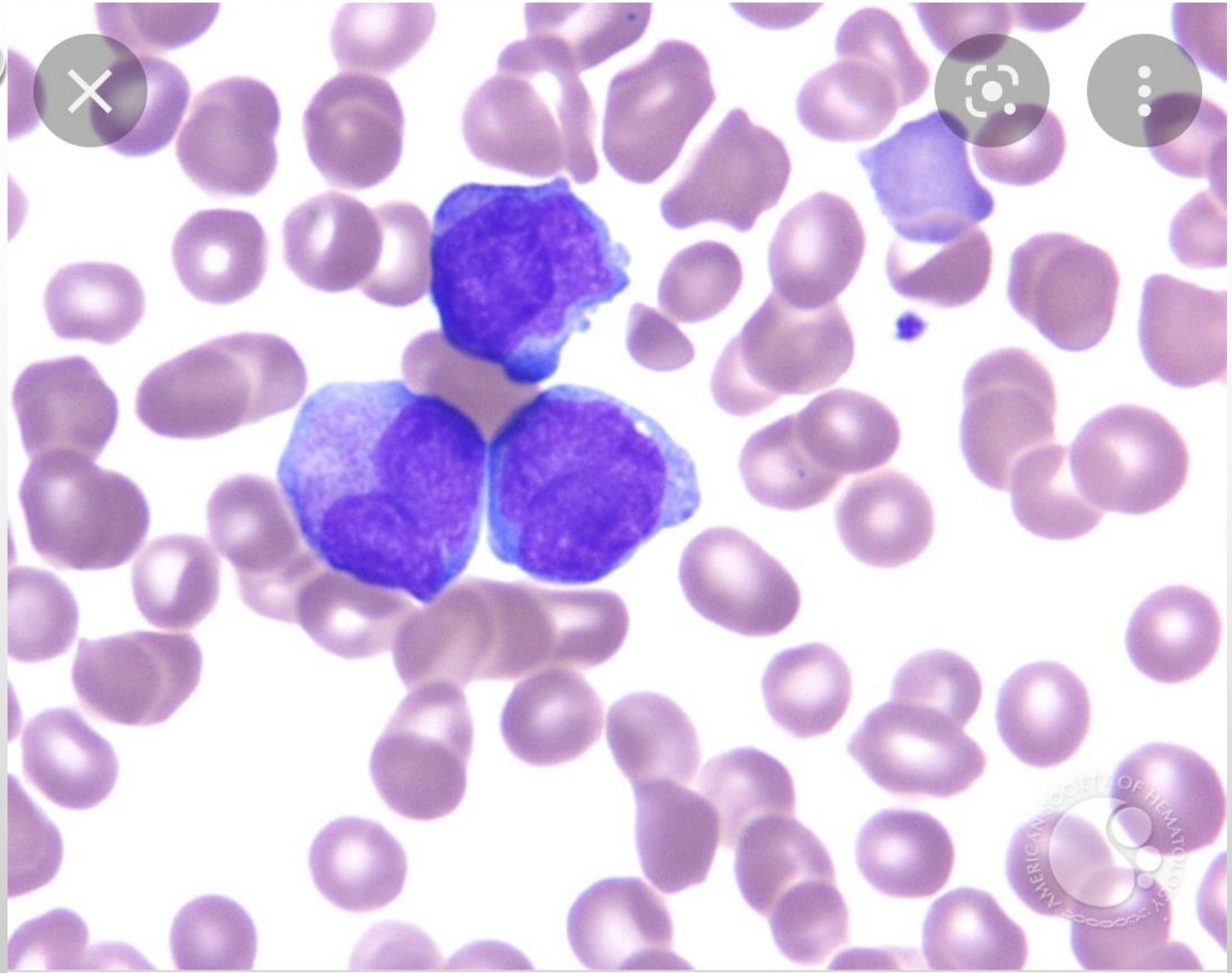
Preethi Paul on Twitter: "Acute Promyelocytic Leukemia APML,...



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AML-M3, Hypogranular Variant - 2.

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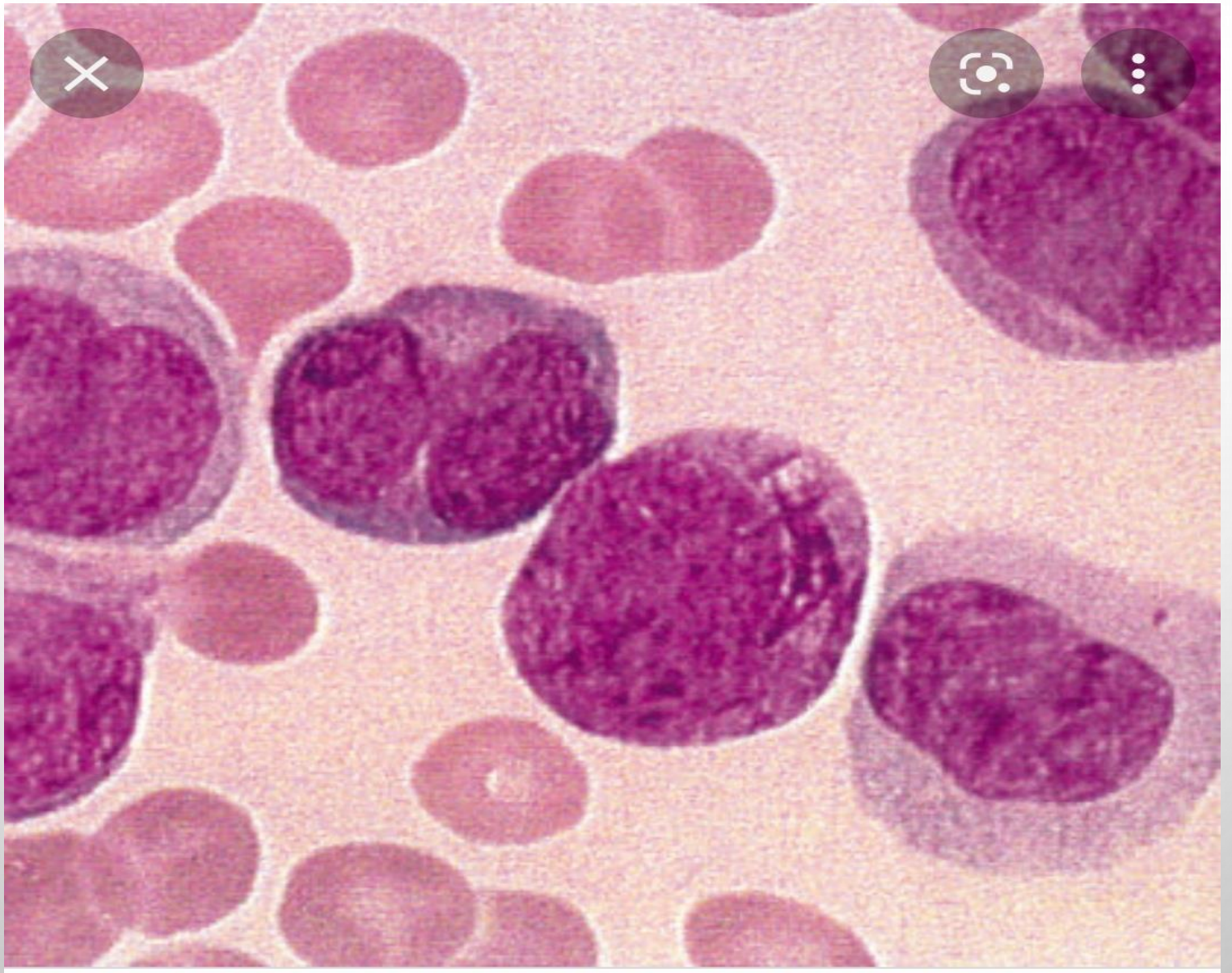

ResearchGate

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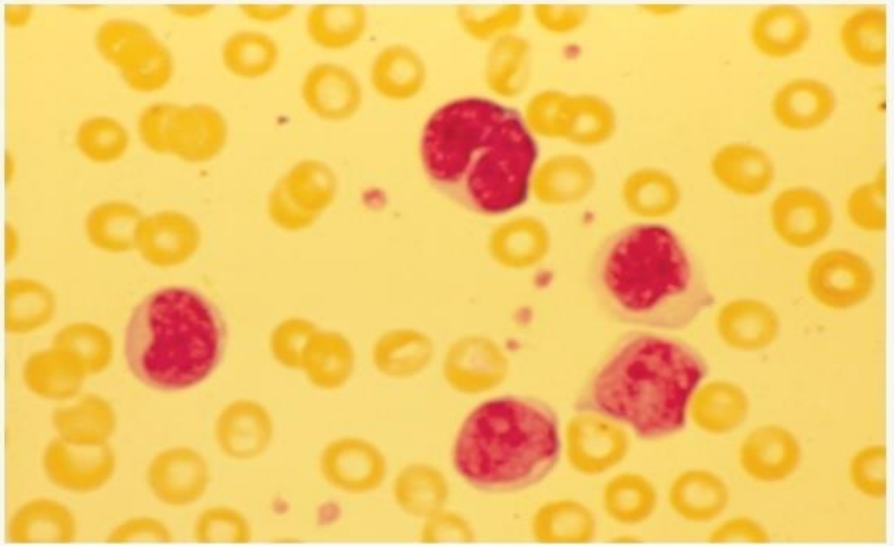
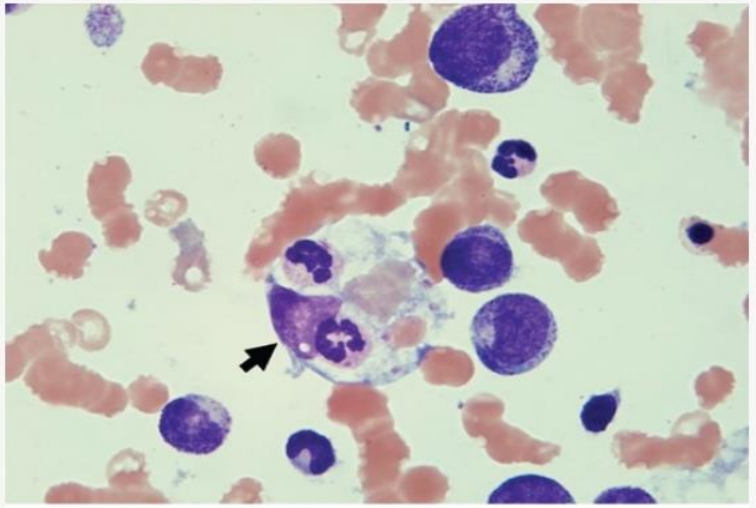
AML (FAB M3). Microgranular variant with t(15;17). The majority of ...

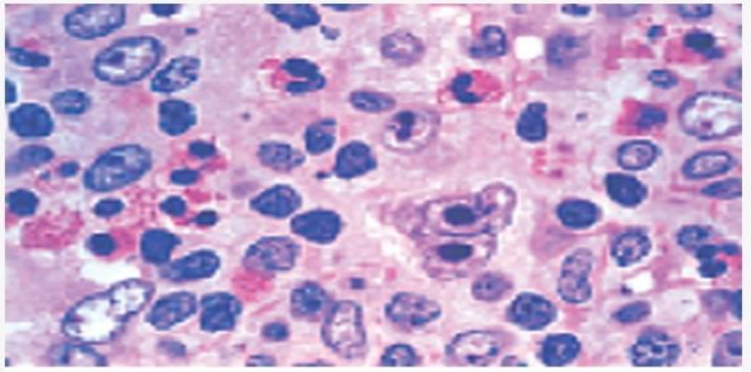
Sézary's syndrome. Lymphocytes with frequently convoluted nuclei (Sézary cells) in a patient with advanced mycosis fungoides.



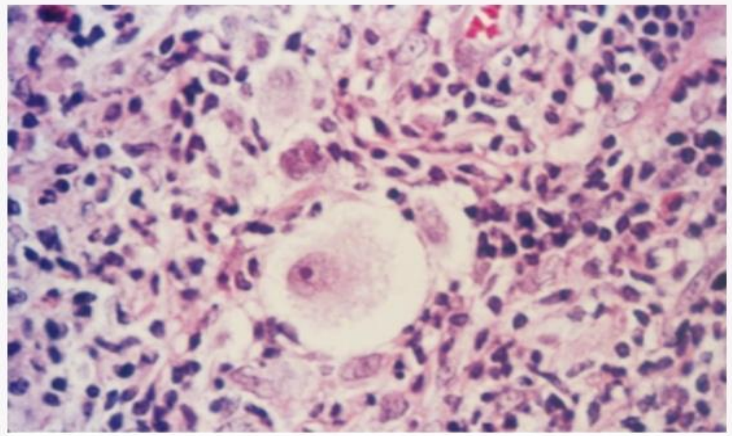
Erythrophagocytosis accompanying aggressive lymphoma. The central macrophage is ingesting red cells, neutrophils, and platelets. *(Courtesy of Dr. Kiyomi Tsukimori, Kyushu University, Fukuoka, Japan.)*



Hodgkin's disease. A Reed-Sternberg cell is present near the center of the field; a large cell with a bilobed nucleus and prominent nucleoli giving an "owl's eyes" appearance. The majority of the cells are normal lymphocytes, neutrophils, and eosinophils that form a pleiomorphic cellular infiltrate.



Lacunar cell; Reed-Sternberg cell variant in nodular sclerosing Hodgkin's disease. High-power view of single mononuclear lacunar cell with retracted cytoplasm in a patient with nodular sclerosing Hodgkin's disease.



END

THANK YOU