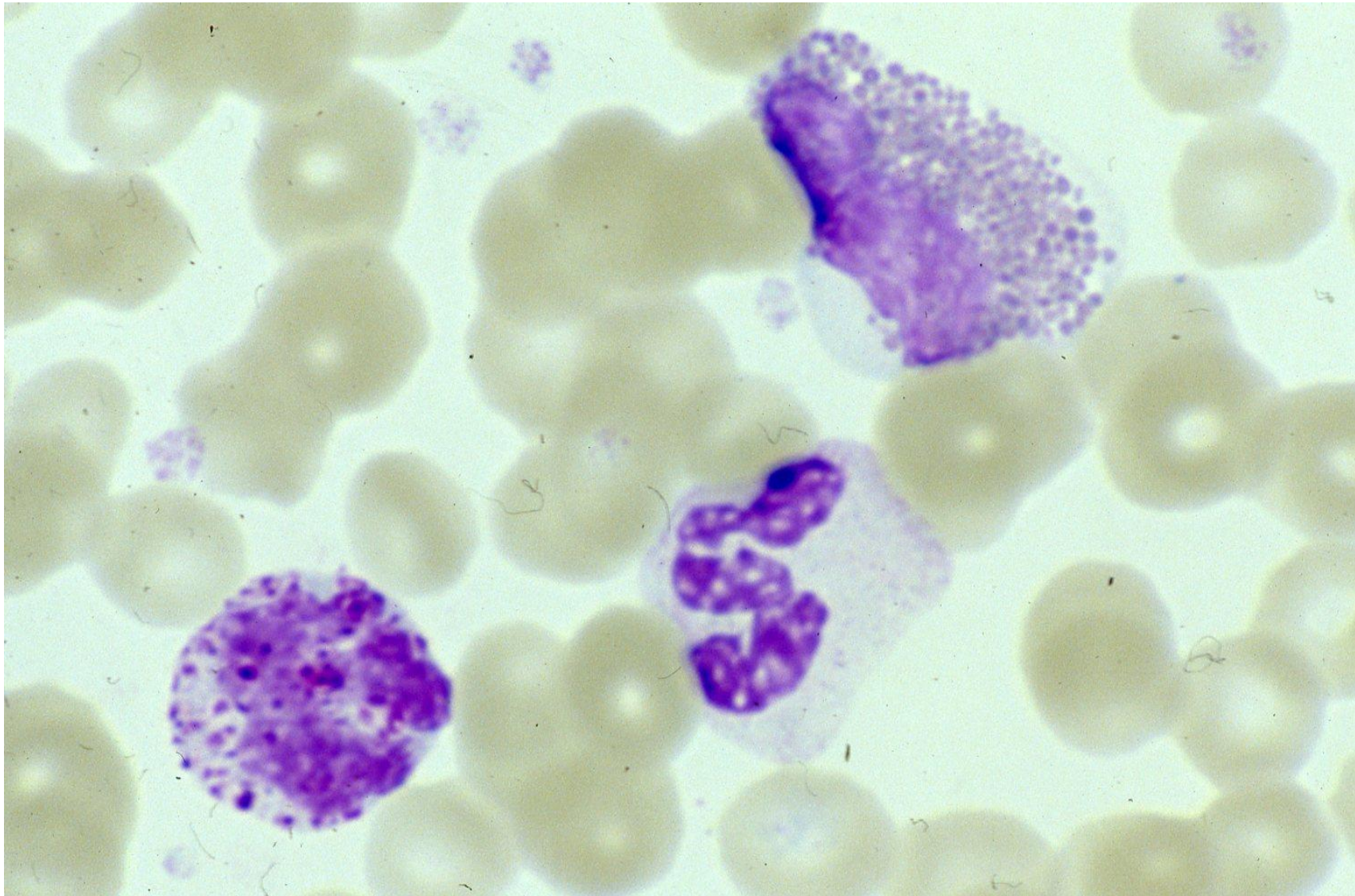


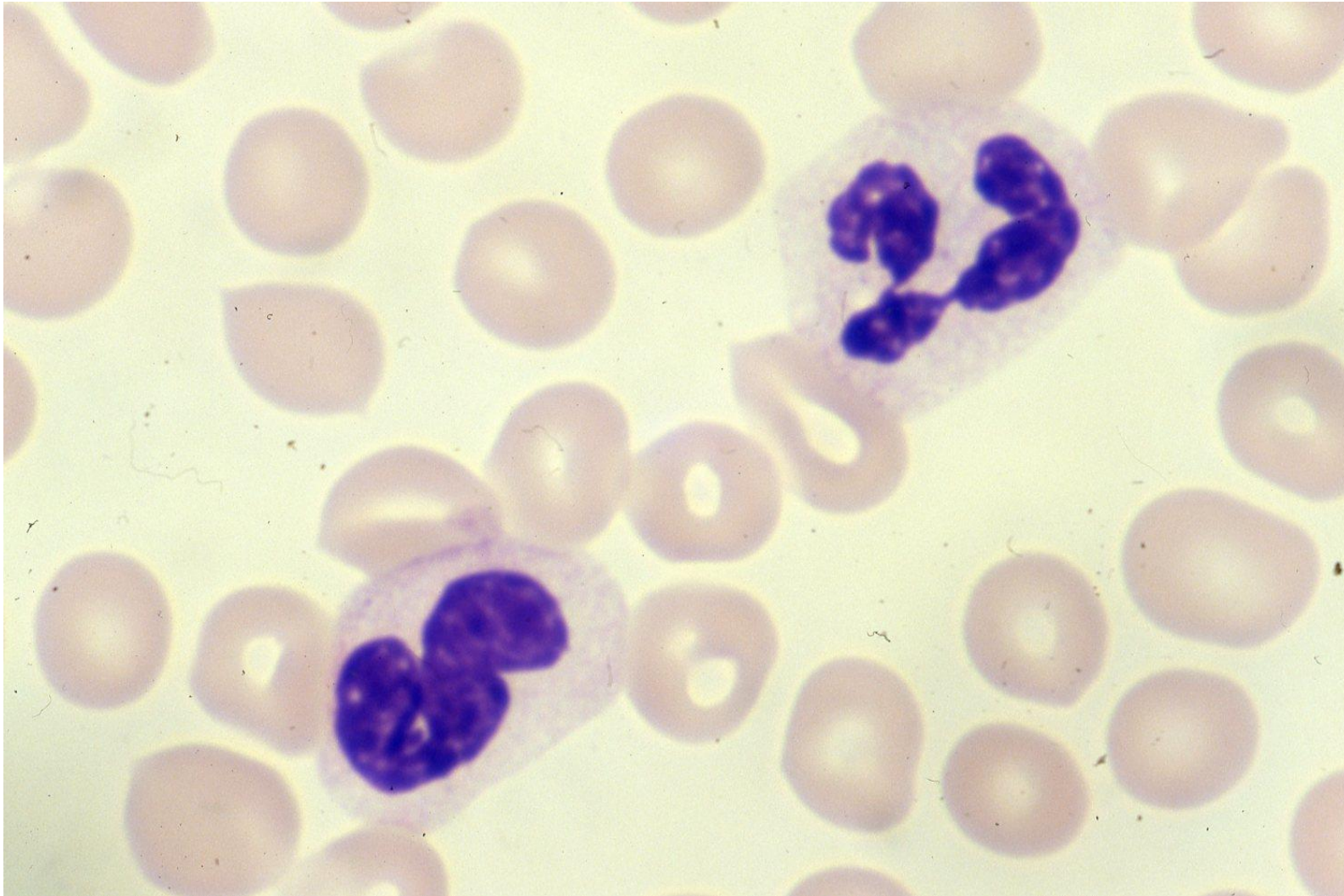
Leukocyte variations in May-Giemsa-stained smears

Morphological variations of white blood cells in the peripheral blood, effusions and bone marrow are presented. Metastatic cancers in the bone marrow are also included. You can get valuable information from the smear preparations.

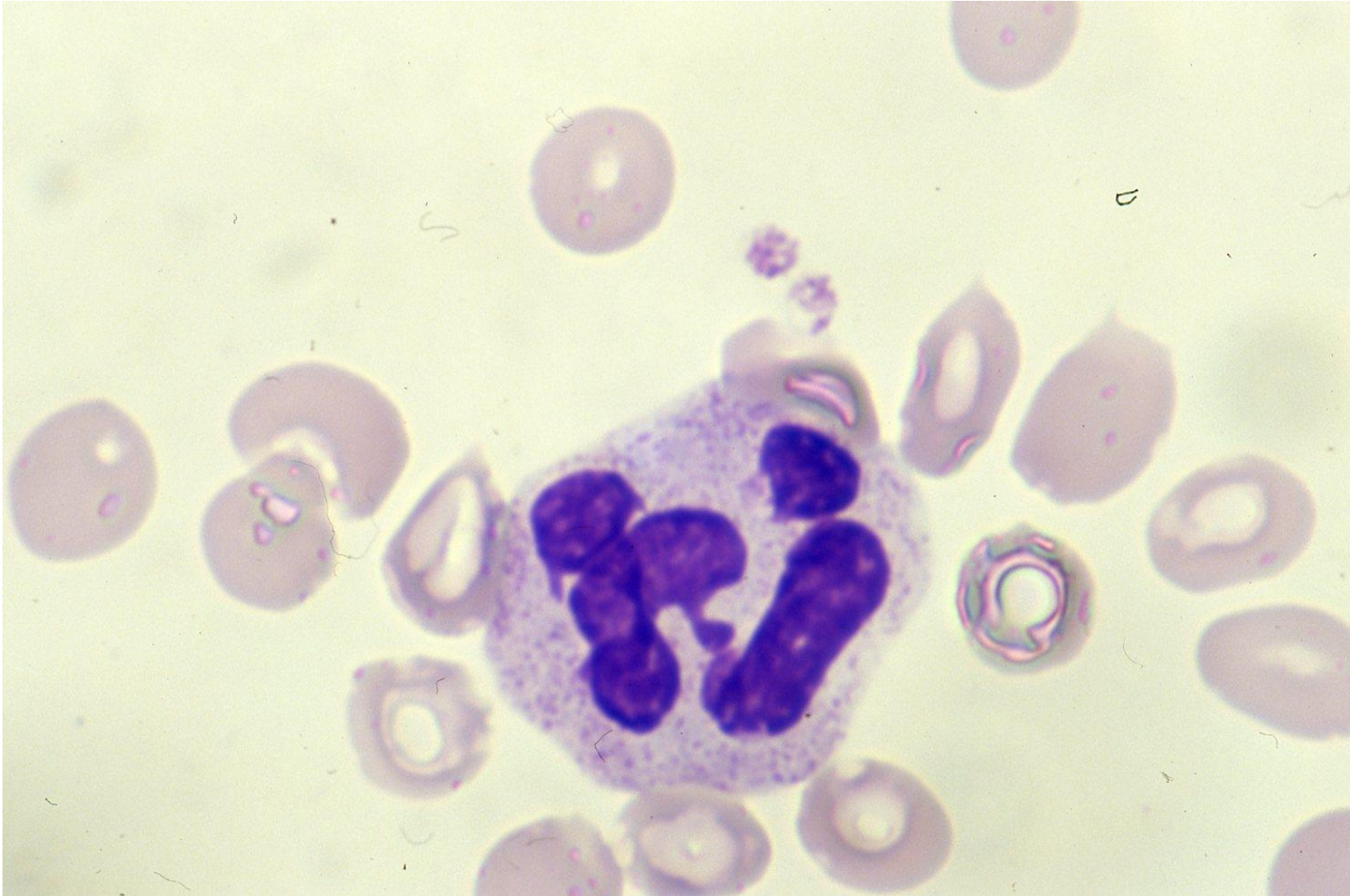
Ref.: Adewoyin AS, Nwogoh B. Peripheral blood film - a review. *Ann Ib Postgrad Med* 2014; 12(2): 71-79. PMID: 25960697



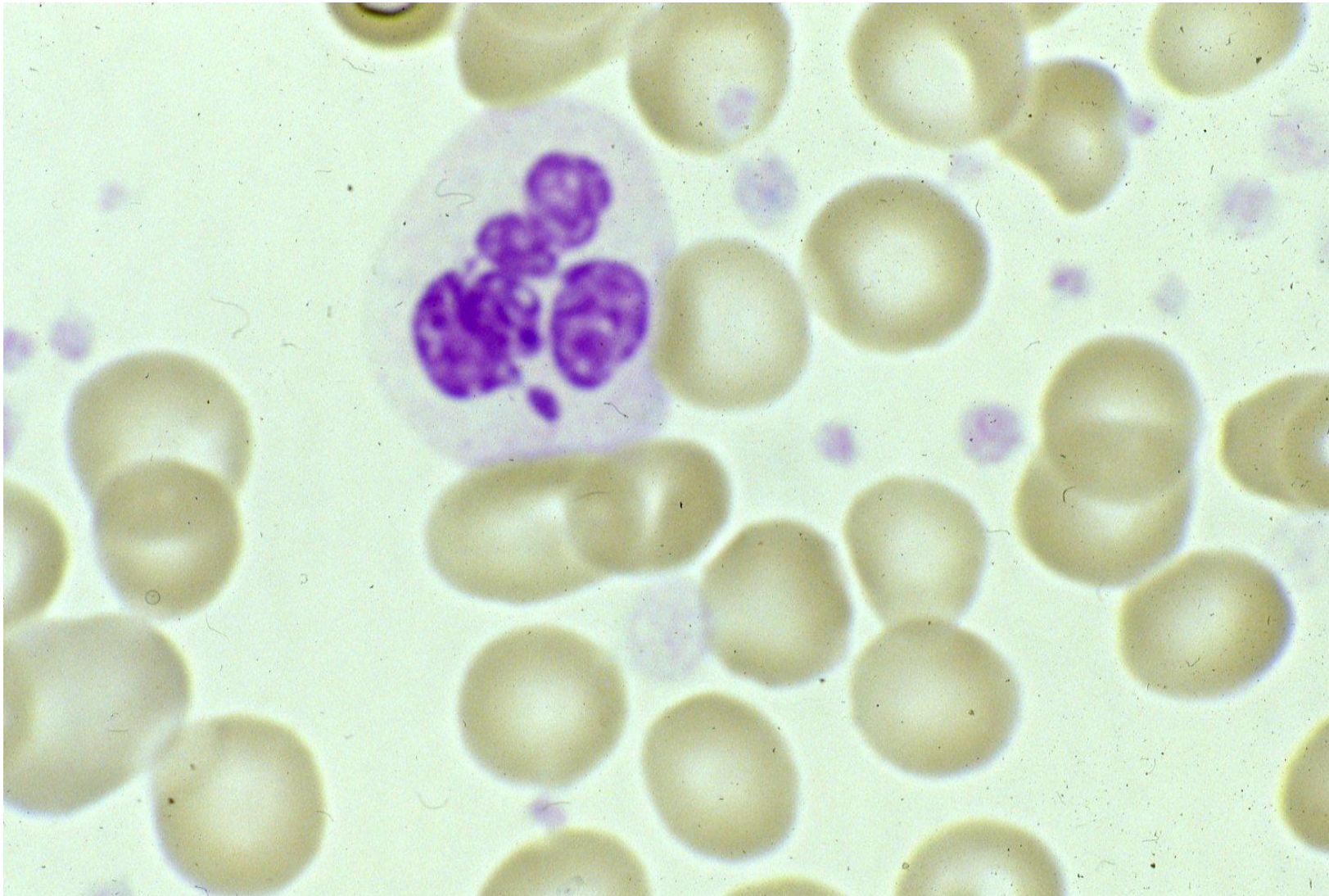
Three kinds of granulocytes. Left: basophil, center: neutrophil, right: eosinophil. The unique trio was photographed in the bone marrow smear of a CML case. May-Giemsa



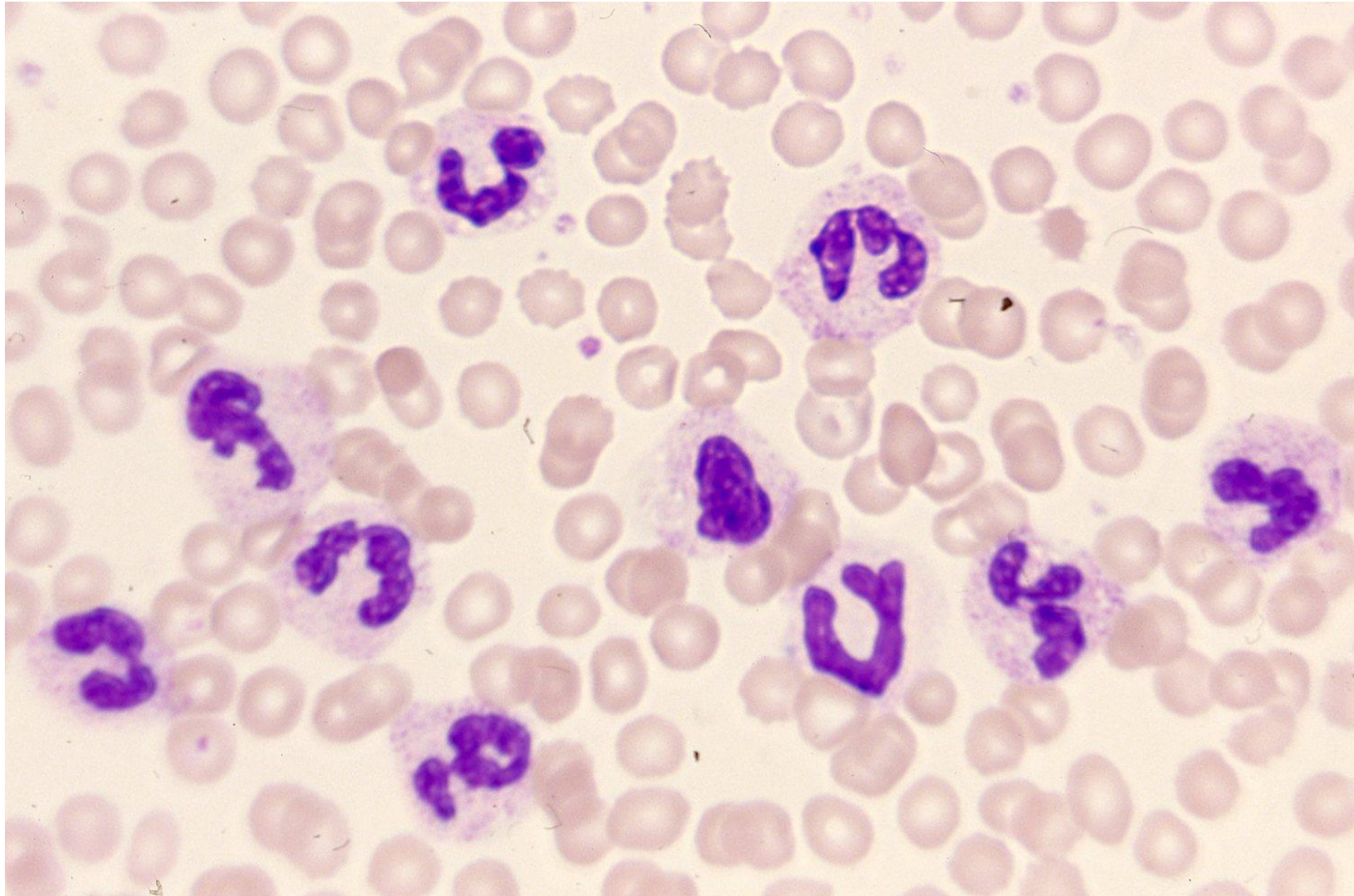
Neutrophils in the peripheral blood. Left: band form, right: segmented form. May-Giemsa



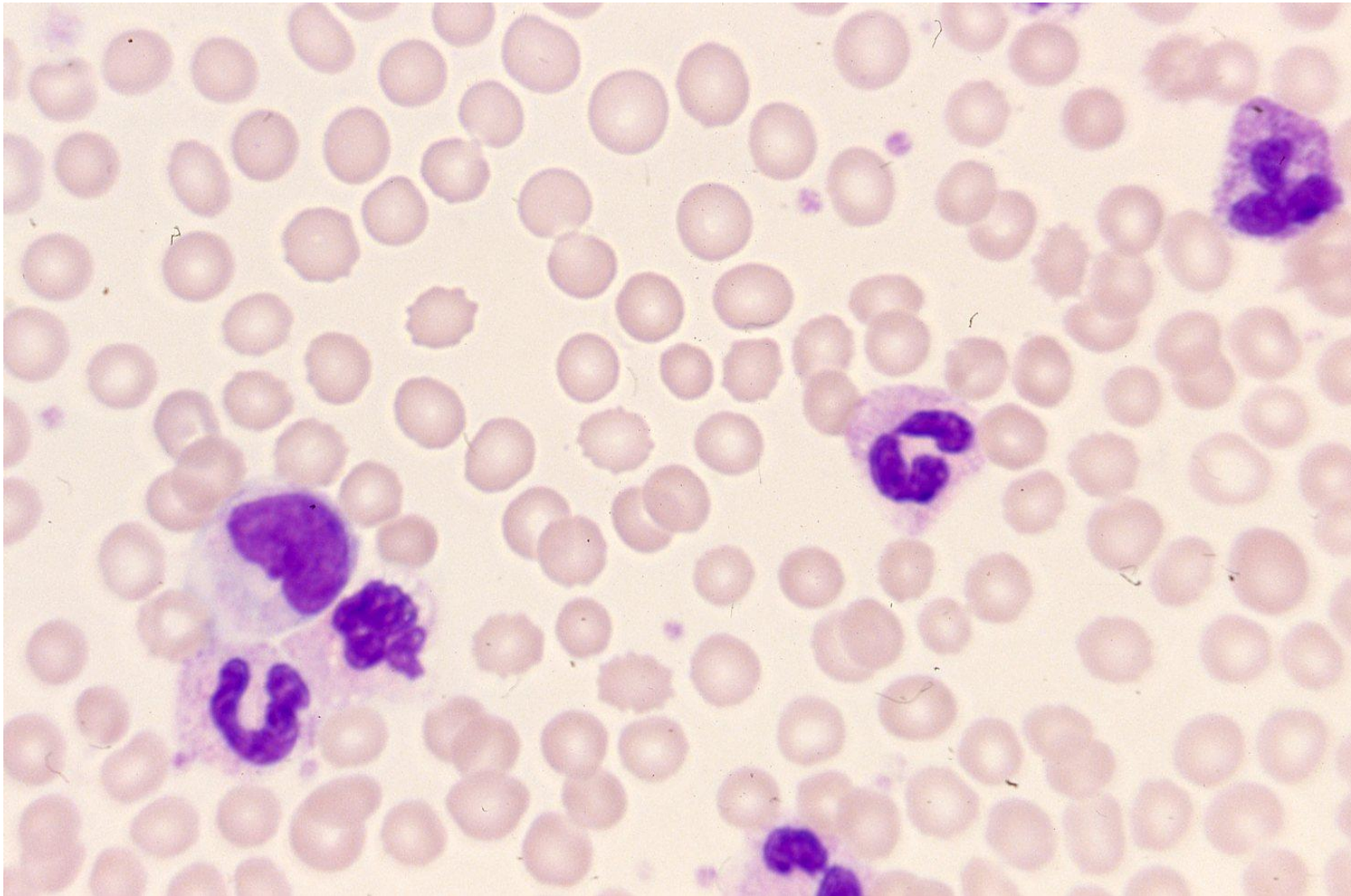
A hypersegmented neutrophils in a case of pernicious anemia. May-Giemsa



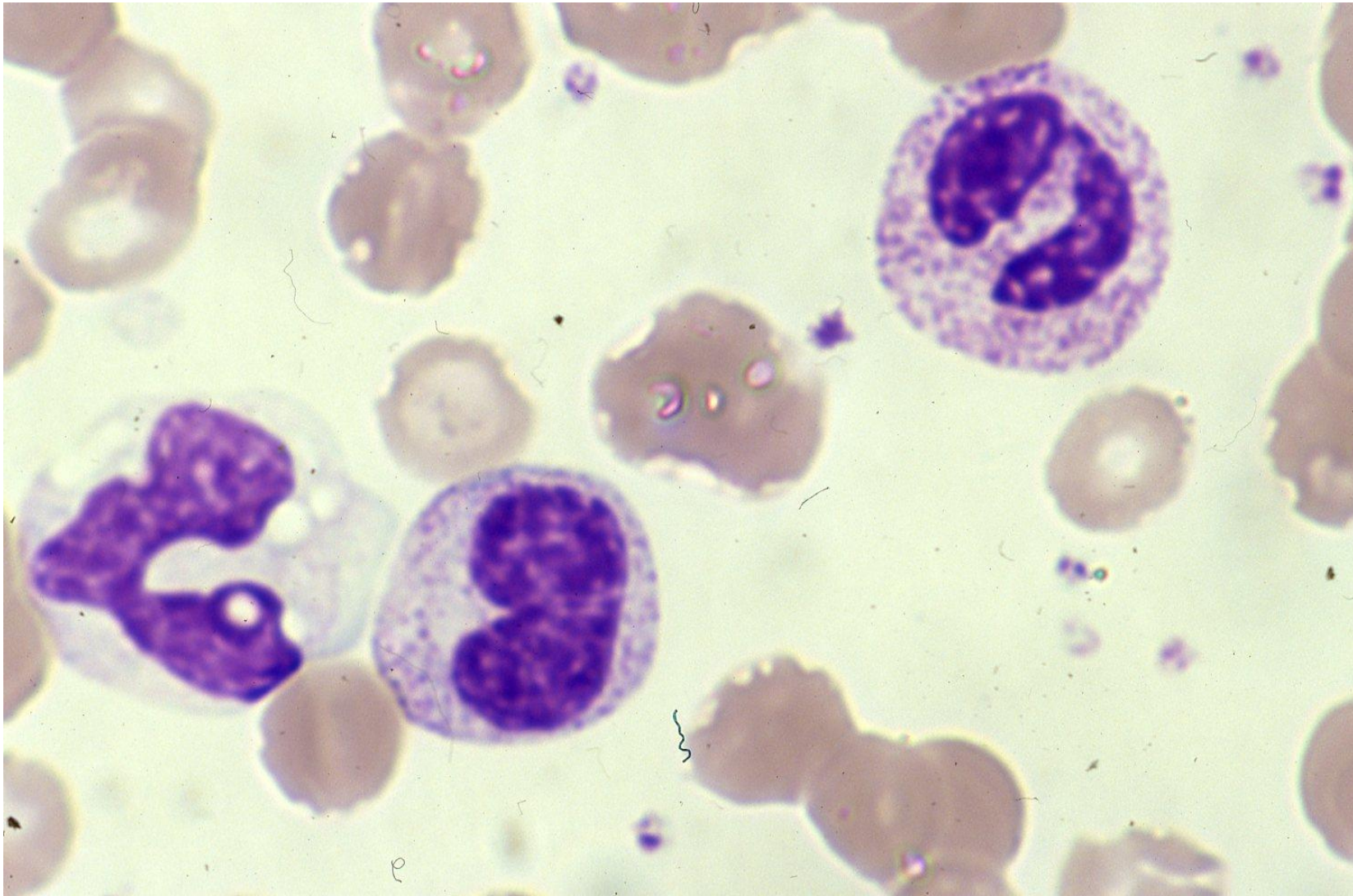
Drumstick in the neutrophil in a female case. Drumsticks appear when two XX chromosomes are present. Women have drumsticks in about 3% of the neutrophils. The active X chromosome is randomly distributed in nuclear lobes, while the inactive X preferentially appears as drumsticks. May-Giemsa



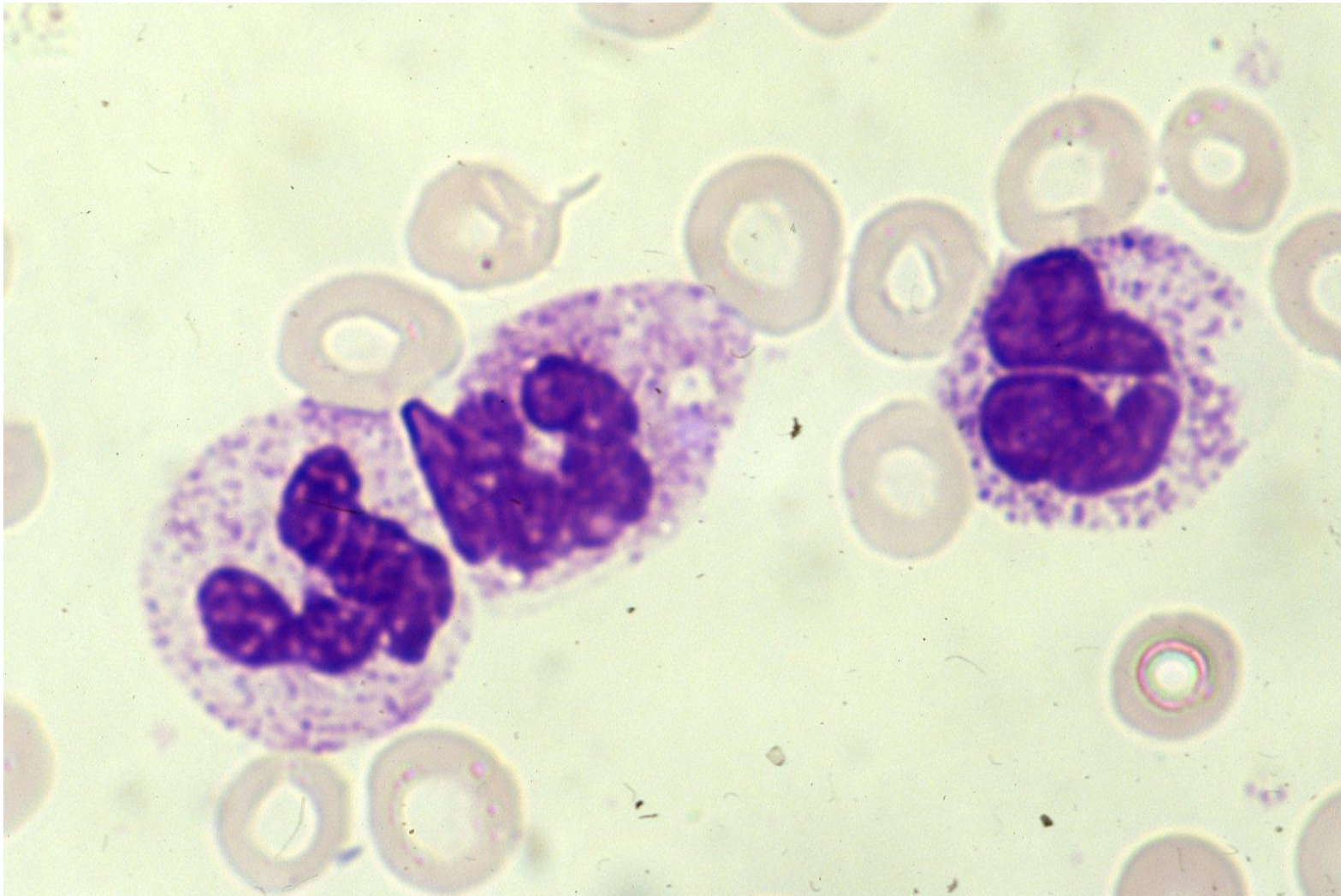
Leukocytosis in the peripheral blood. Normally, the RBC to WBC ratio is around 500-600. In the photograph of the peripheral blood smear, the photographer intends to include one or two leukocytes in the field. Here, the ratio is 165:10 (16.5). When the red cell count is 4,000,000/ μ L, the WBC count should be 240,000/ μ L, the level of CML. May-Giemsa



Leukocytosis in the peripheral blood. Normally, the RBC to WBC ratio is around 500-600. In the photograph of the peripheral blood smear, the photographer intends to include one or two leukocytes in the field. In this case, the ratio is 158:6 (26.3). When the red cell count is 4,000,000/ μ L, the WBC count should be 152,000/ μ L, the level of CML. May-Giemsa



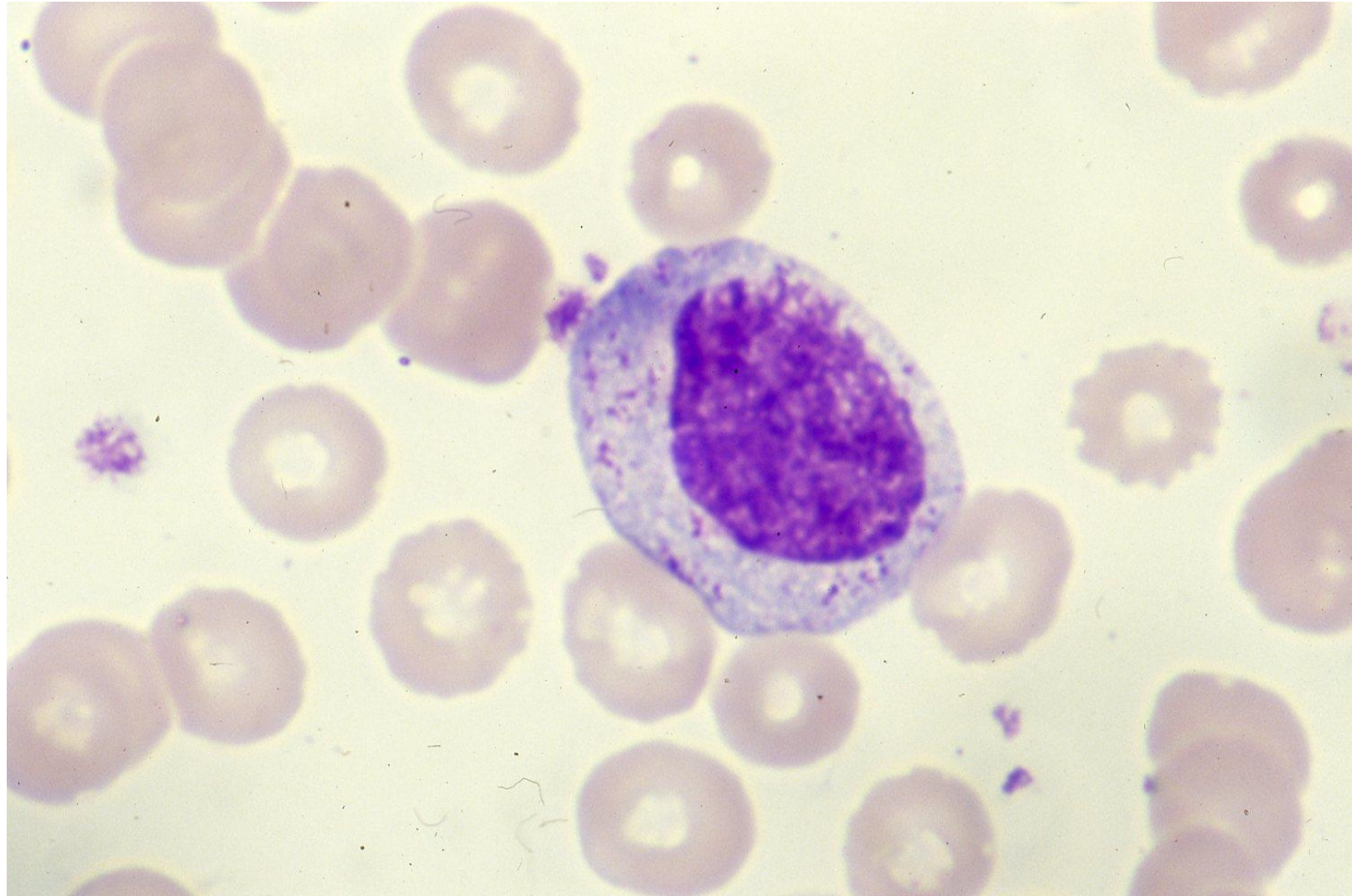
Toxic granules in neutrophils after the use of granulocyte-colony stimulating factor (G-CSF). Toxic granulation is often found in patients with bacterial infection and sepsis. Patients being treated with chemotherapy or G-CSF may also exhibit toxic granulation. Toxic vacuolation is also seen in one neutrophil. May-Giemsa



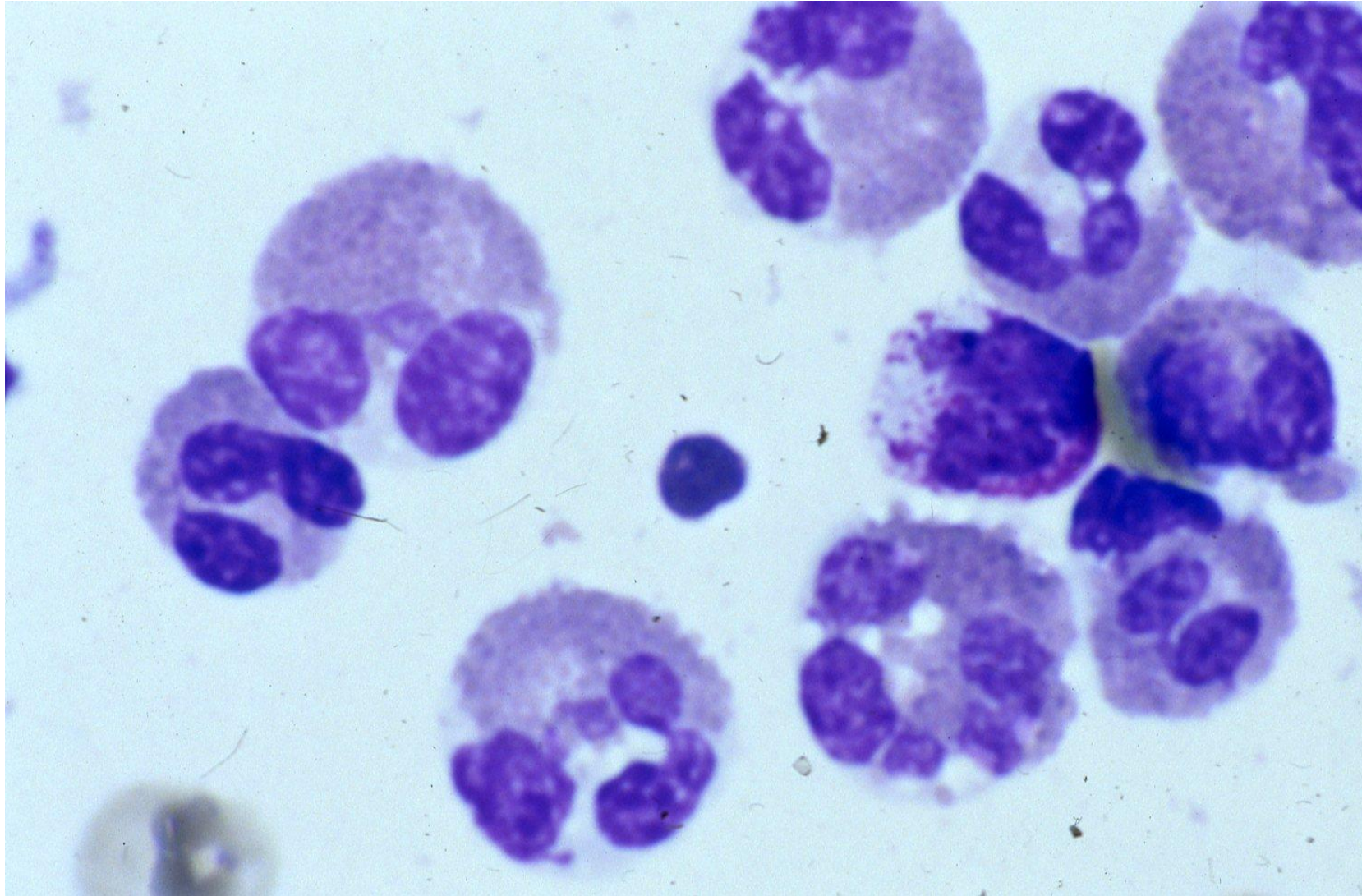
Döhle bodies in neutrophils. Döhle bodies are light blue-gray, oval, basophilic inclusions, measuring 1–3 μm , located in the peripheral cytoplasm of neutrophils. They should be remnants of the rough endoplasmic reticulum. Toxic granules are also observed, indicating increased granulocytopoiesis prompted by severe infection. Ma-Giemsa



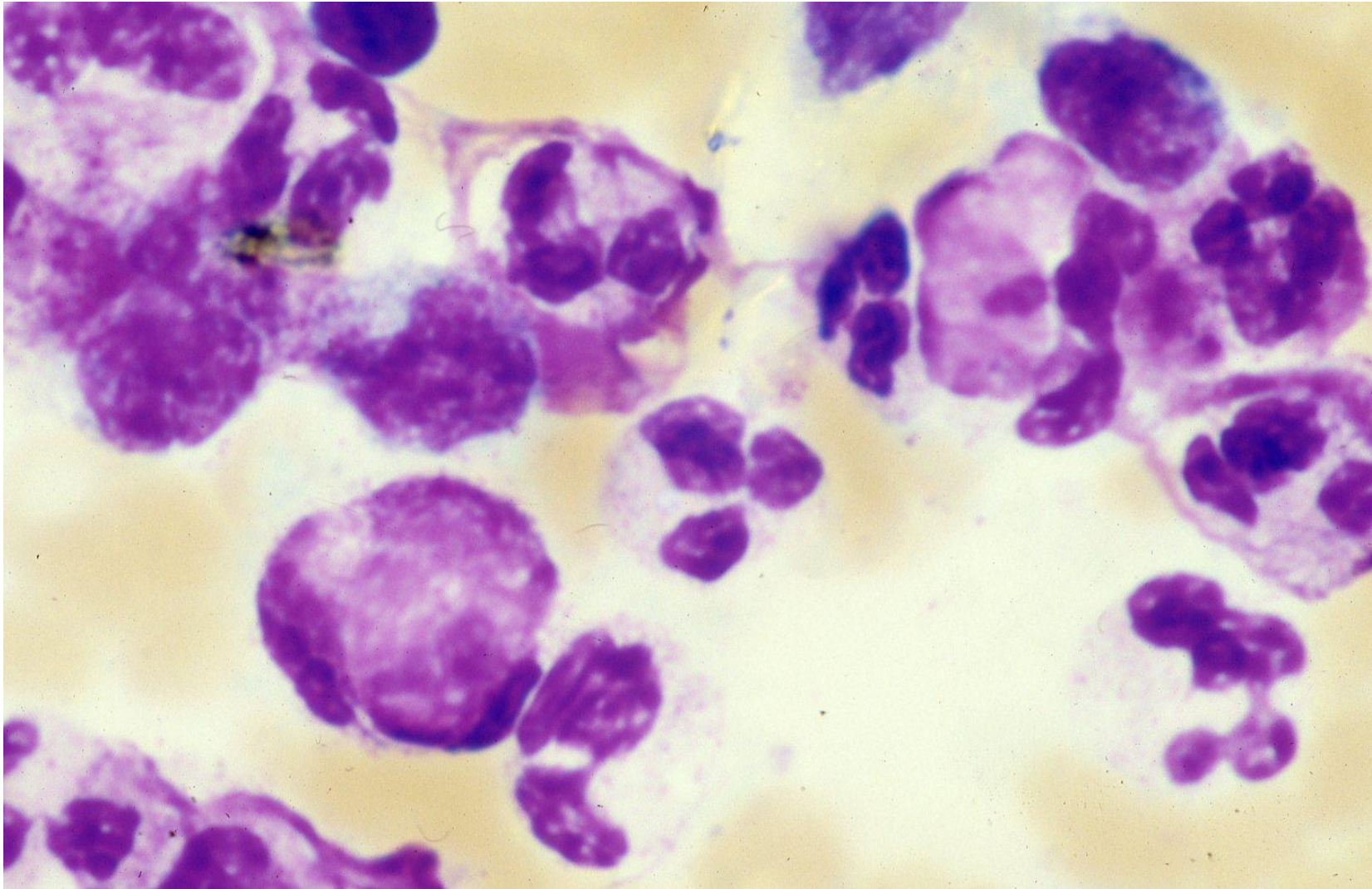
Toxic vacuolation in a neutrophil. Toxic vacuolation is associated with sepsis and bacterial infection. Alcohol toxicity, liver failure and treatment with G-CSF may also provoke toxic vacuoles in neutrophils. May-Giemsa



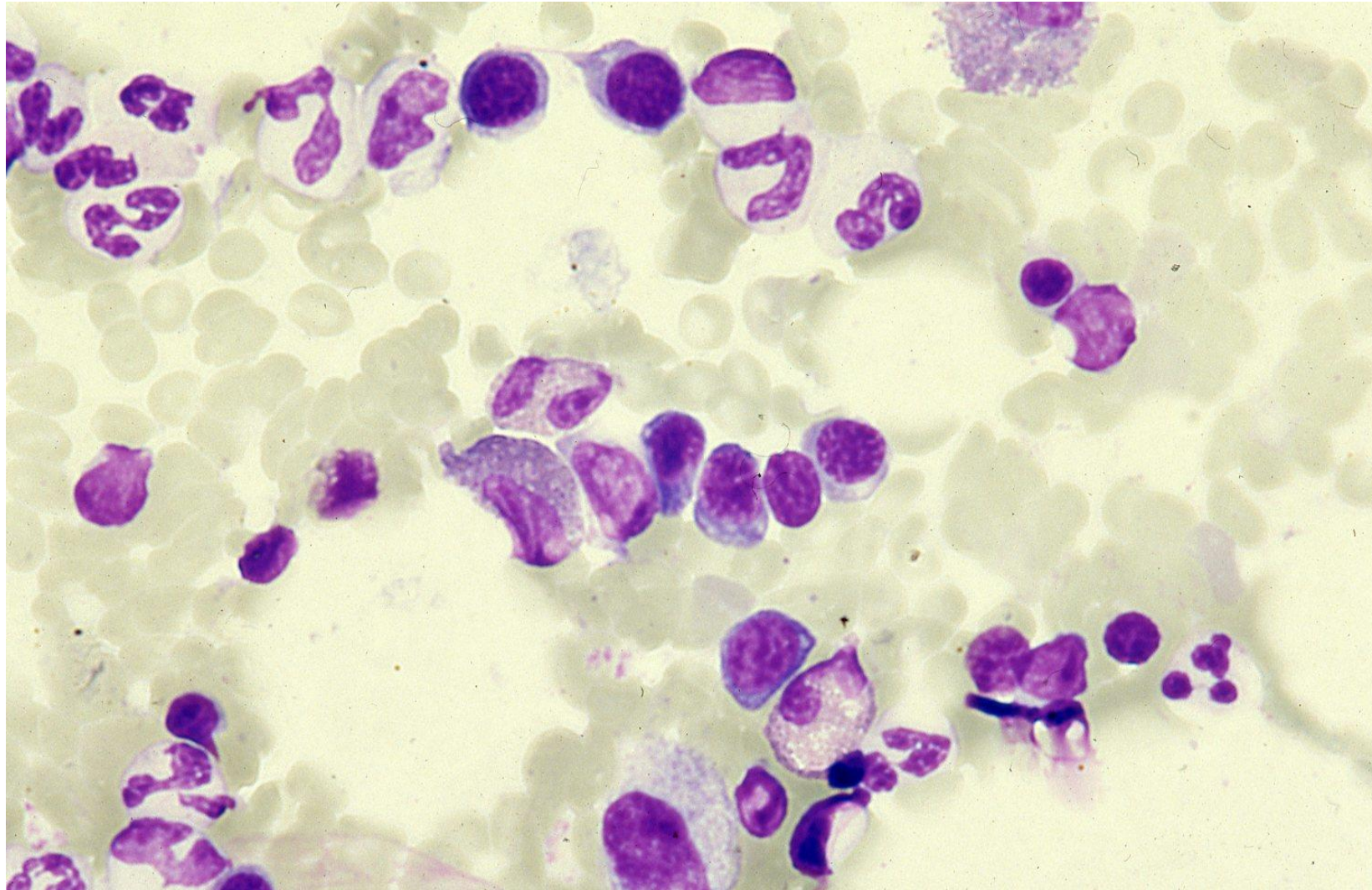
Myelocyte seen in the peripheral blood after injection of G-CSF. Immature myeloid cells appear in the peripheral blood by activation of leukocytopoiesis in the bone marrow. May-Giemsa



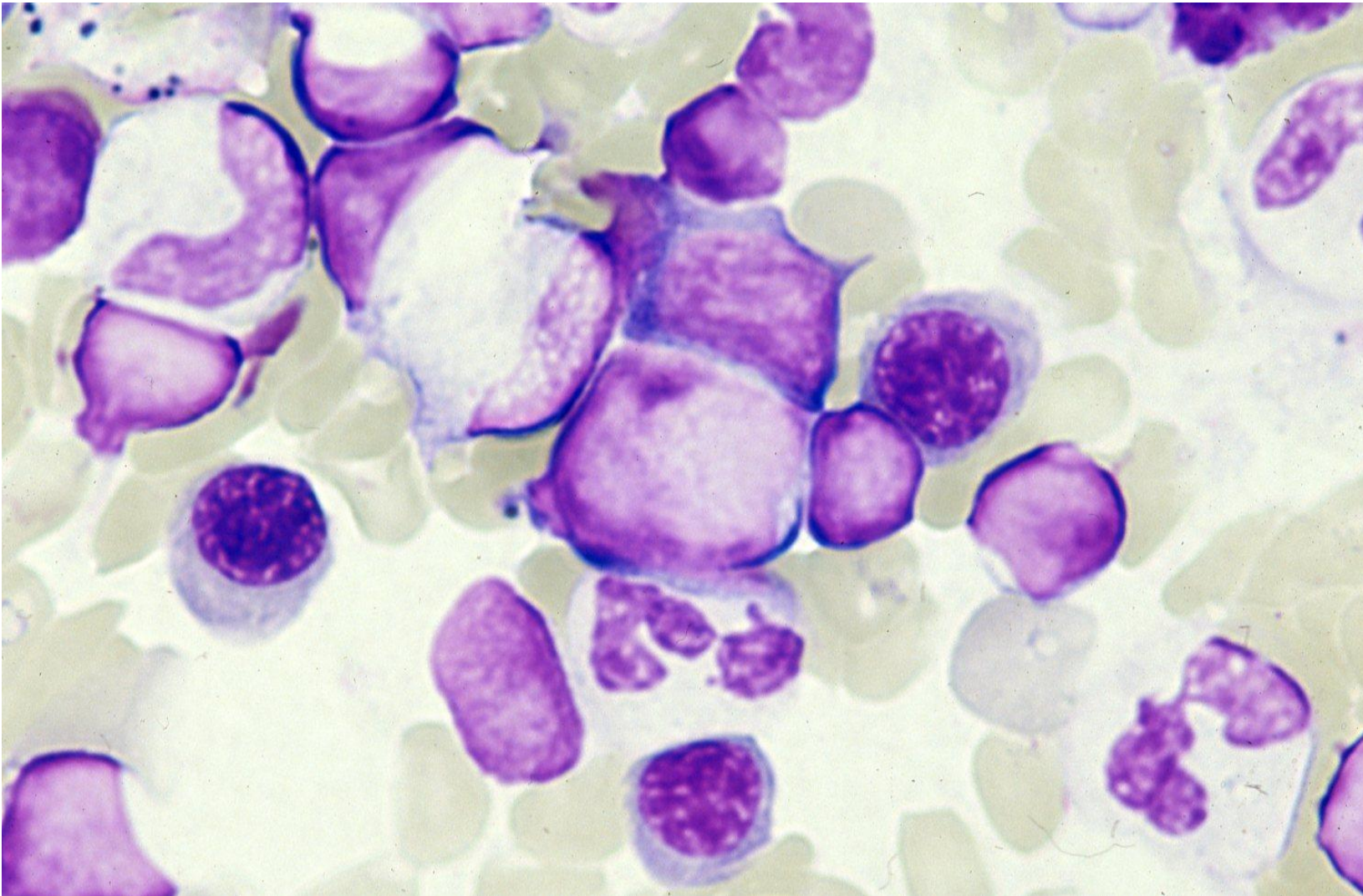
Eosinophilia in pleural effusion. Bilobulation is typical nuclear morphology of the eosinophil. Allergic state or parasitic infestation is a possible cause of eosinophilic immobilization. May-Giemsa



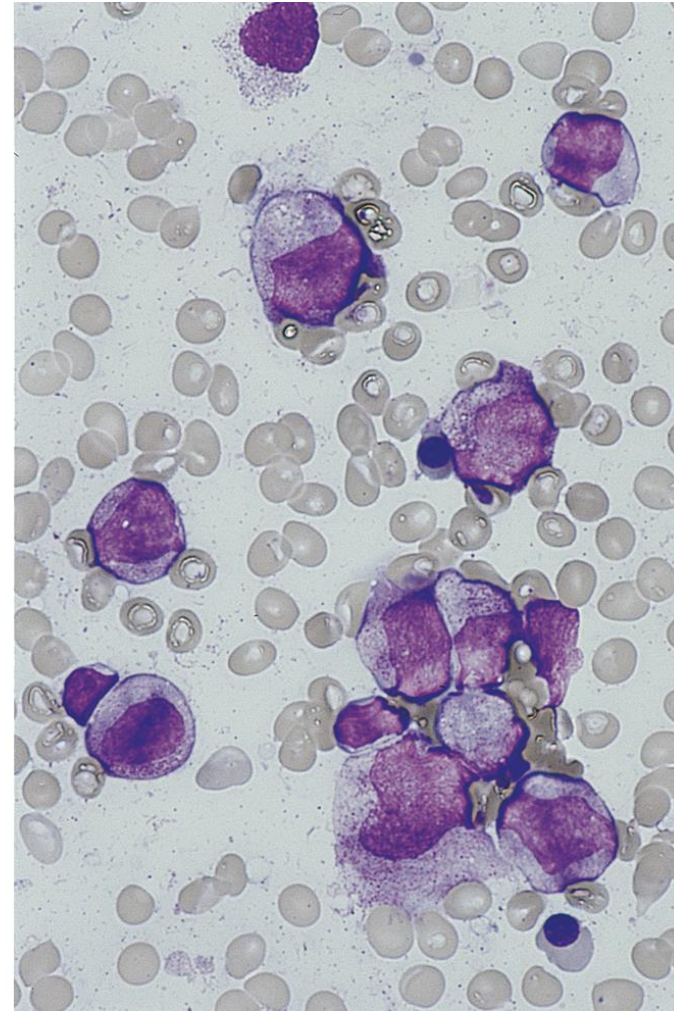
An lupus erythematosus cell (LE cell) in hemorrhagic pleural effusion. Neutrophil phagocytizes anti-DNA autoantibody-mediated, denatured nuclear material of another cell. The basophilic material appears as a hematoxylin body. LE cells are usually induced *in vitro*, but LE cells are seen *in vivo* in pleural effusion of an SLE patient. May-Giemsa



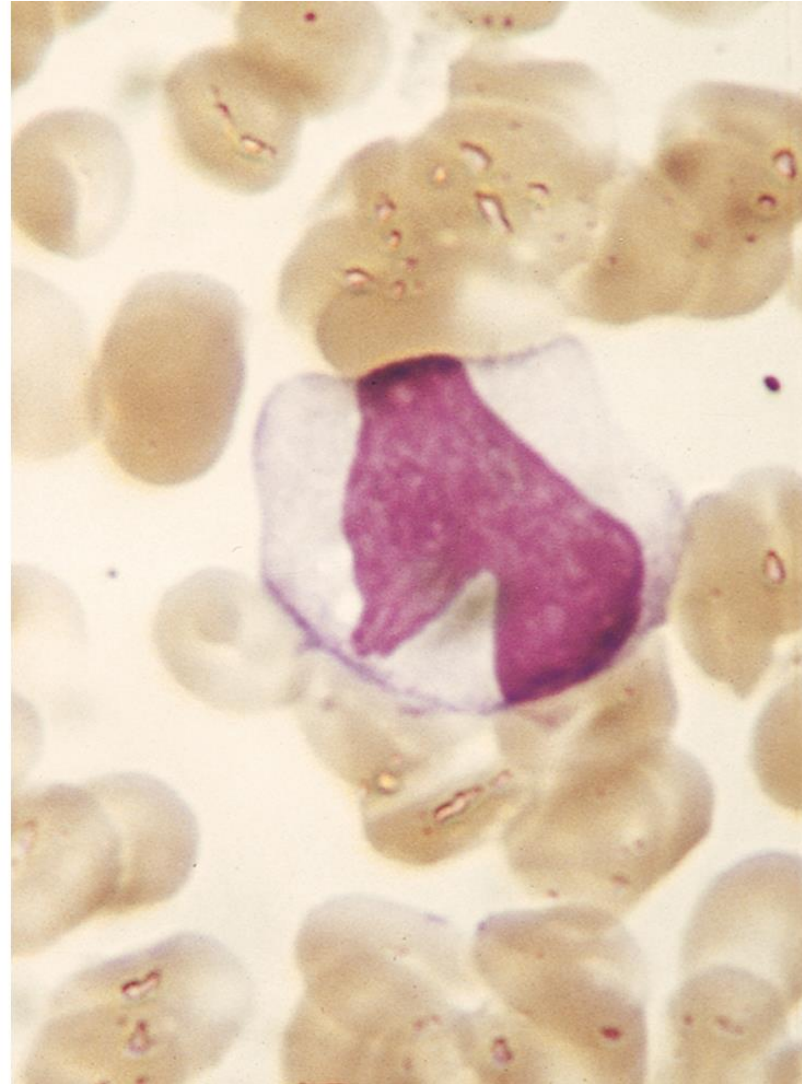
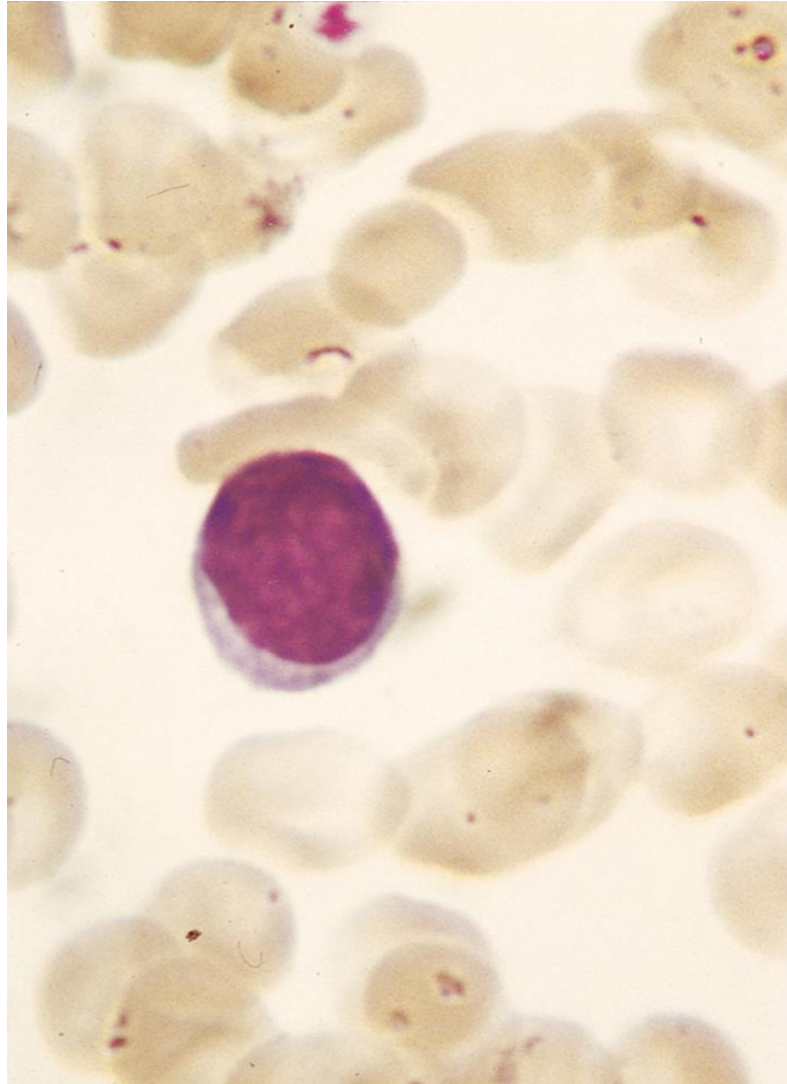
Normal features of bone marrow aspiration (1). Note cells of myeloid and erythroid series. An immature eosinophil is seen in the center. May-Giemsa



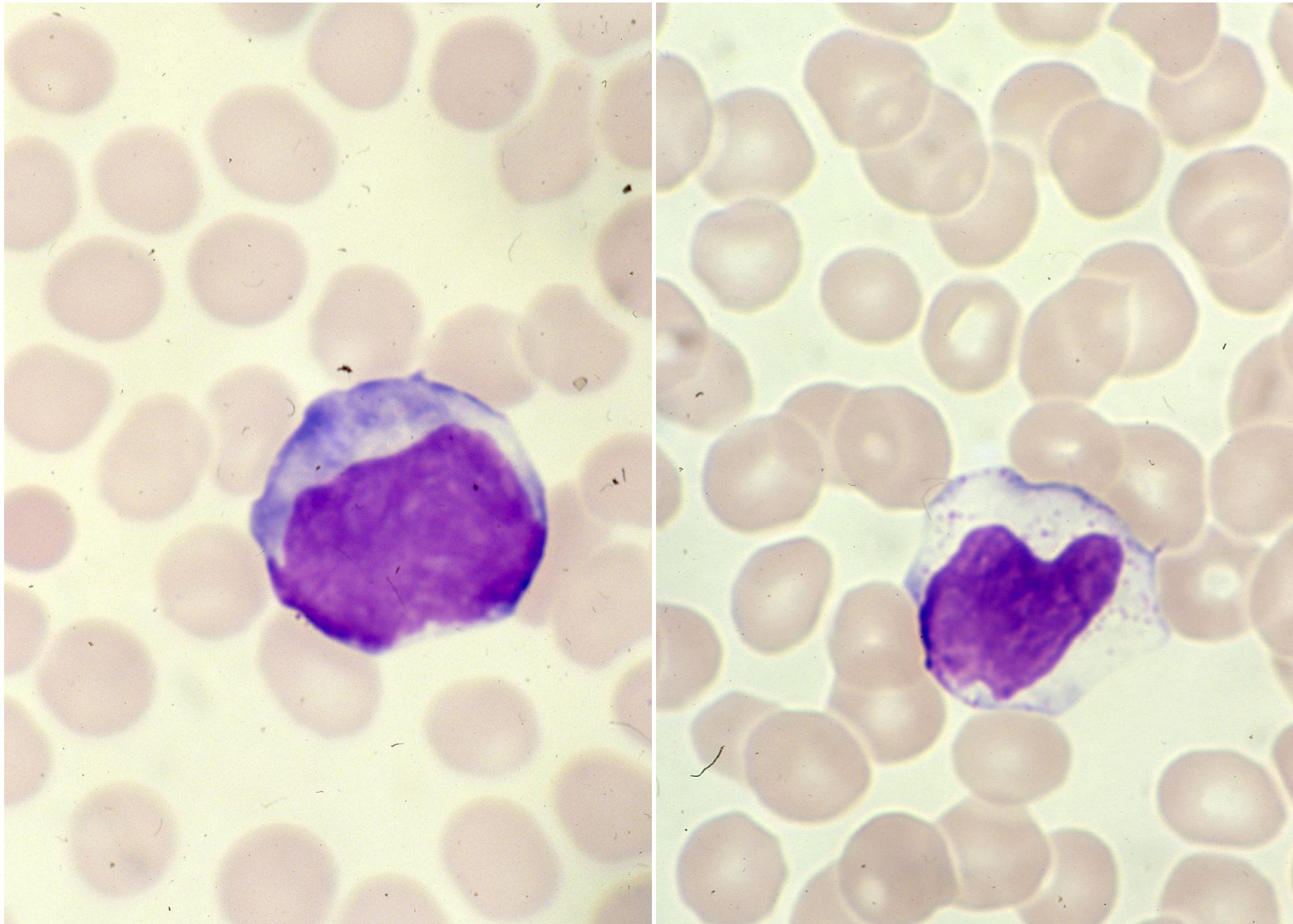
Normal features of bone marrow aspiration (2). Immature myeloid cells with basophilic cytoplasm are seen in the center. Erythroblasts with faintly basophilic cytoplasm are scattered. May-Giemsa



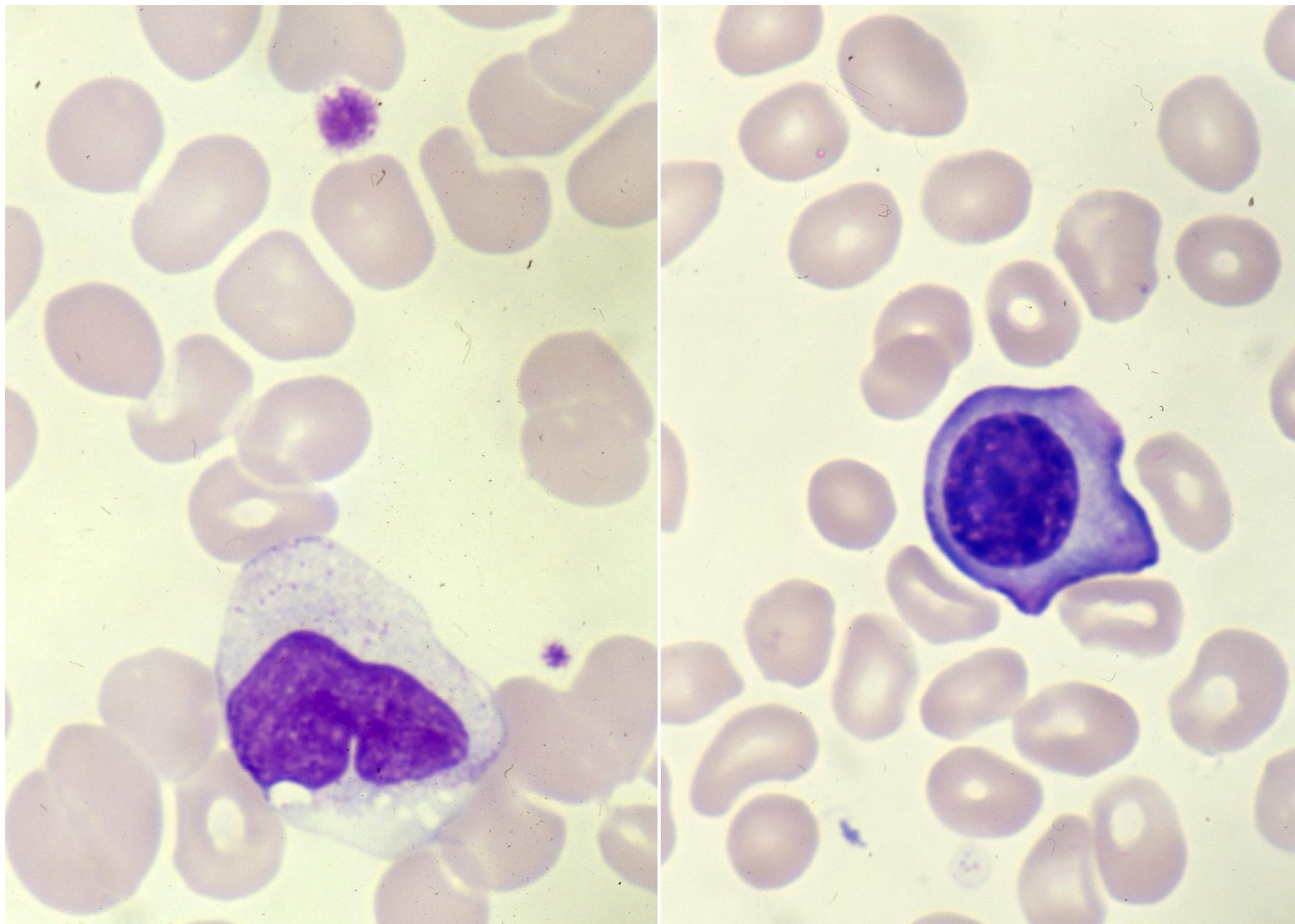
Reactive “shift to left” due to G-CSF administration (left: peripheral blood, right: bone marrow). A 73-year-old man received chemotherapy against recurrent B-cell lymphoma. Leukocyte count was decreased to 500/ μL , and G-CSF was administered for 4 days. The peripheral blood reveals shift to left with the appearance of myelocytes. Formation of toxic granules and Döhle bodies is associated. In the bone marrow, increase of promyelocytes is evident. May-Giemsa



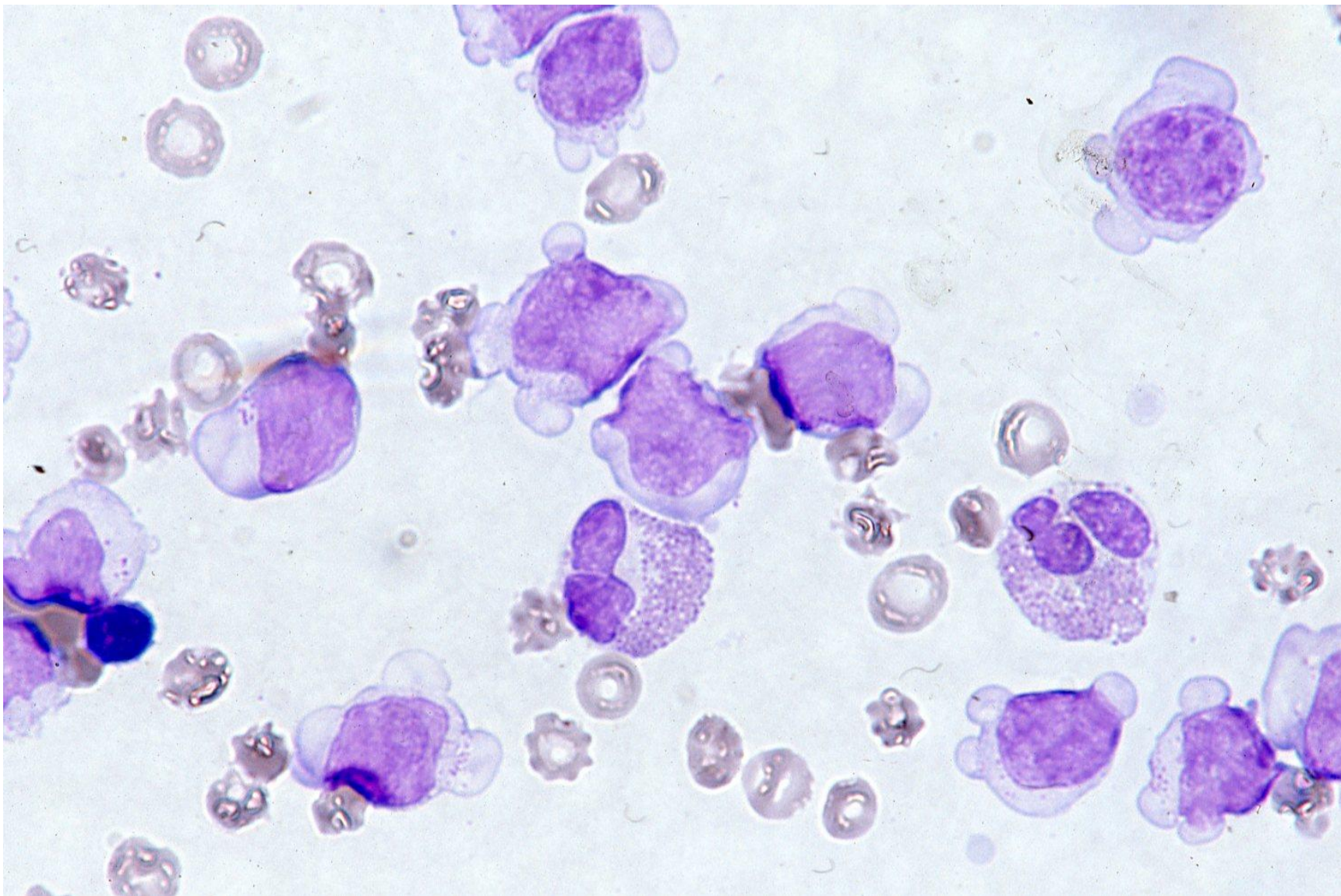
Small lymphocyte (left) and monocytoid atypical lymphocyte (Downey's type I, right) in the peripheral blood. Immune-activated lymphocytes are enlarged to produce a variety of cytokines. Classical Downey's classification is as follows: type I: monocytoid, type II: plasmacytoid, type III: lymphoblastoid. May-Giemsa



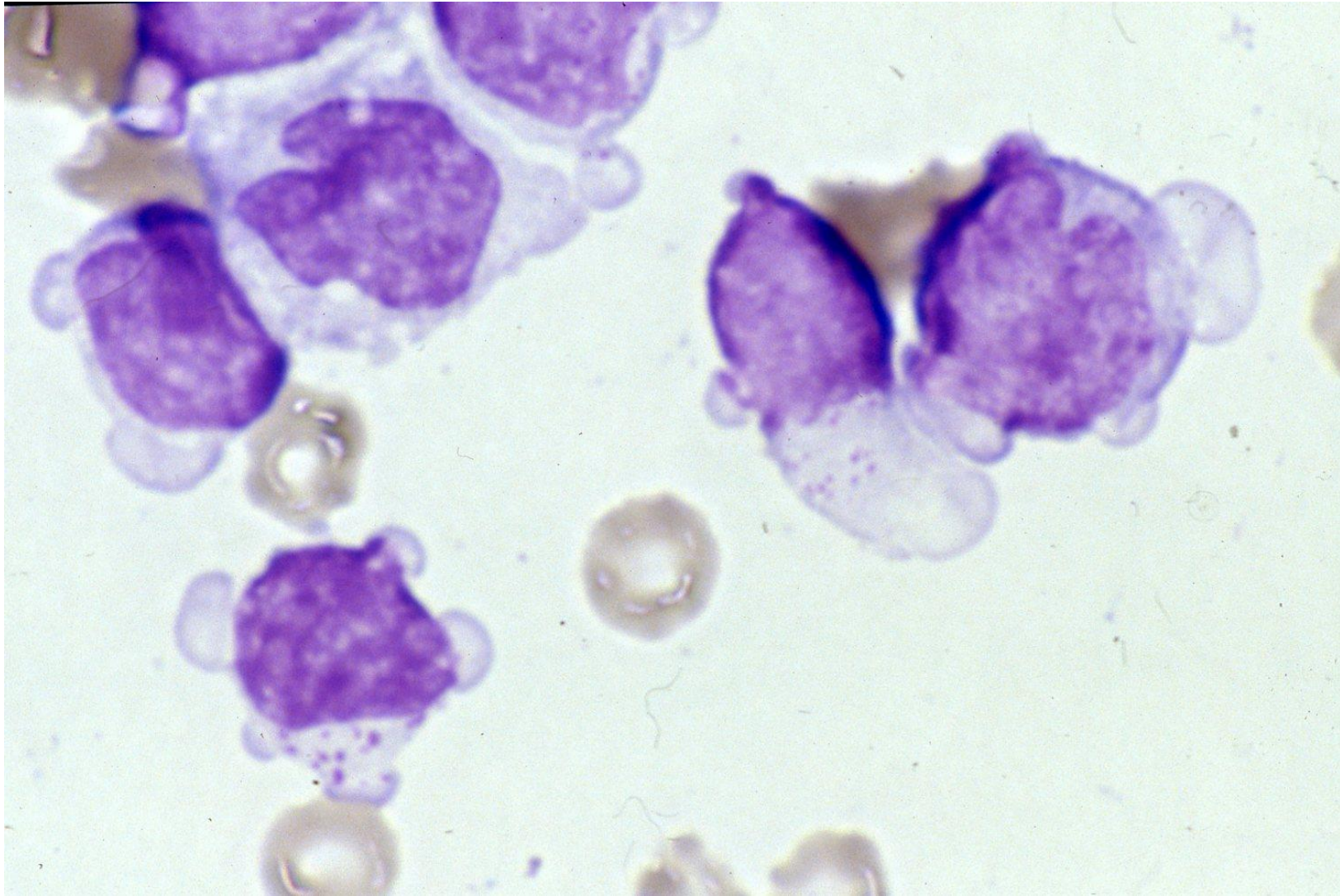
Atypical lymphocytes. Left: lymphoblastoid (Downey's type III), right: large granular lymphocyte (LGL). Lymphoblastoid atypical lymphocytes possess basophilic cytoplasm. LGL contains fine azurophilic granules, representing an activated NK cell. May-Giemsa



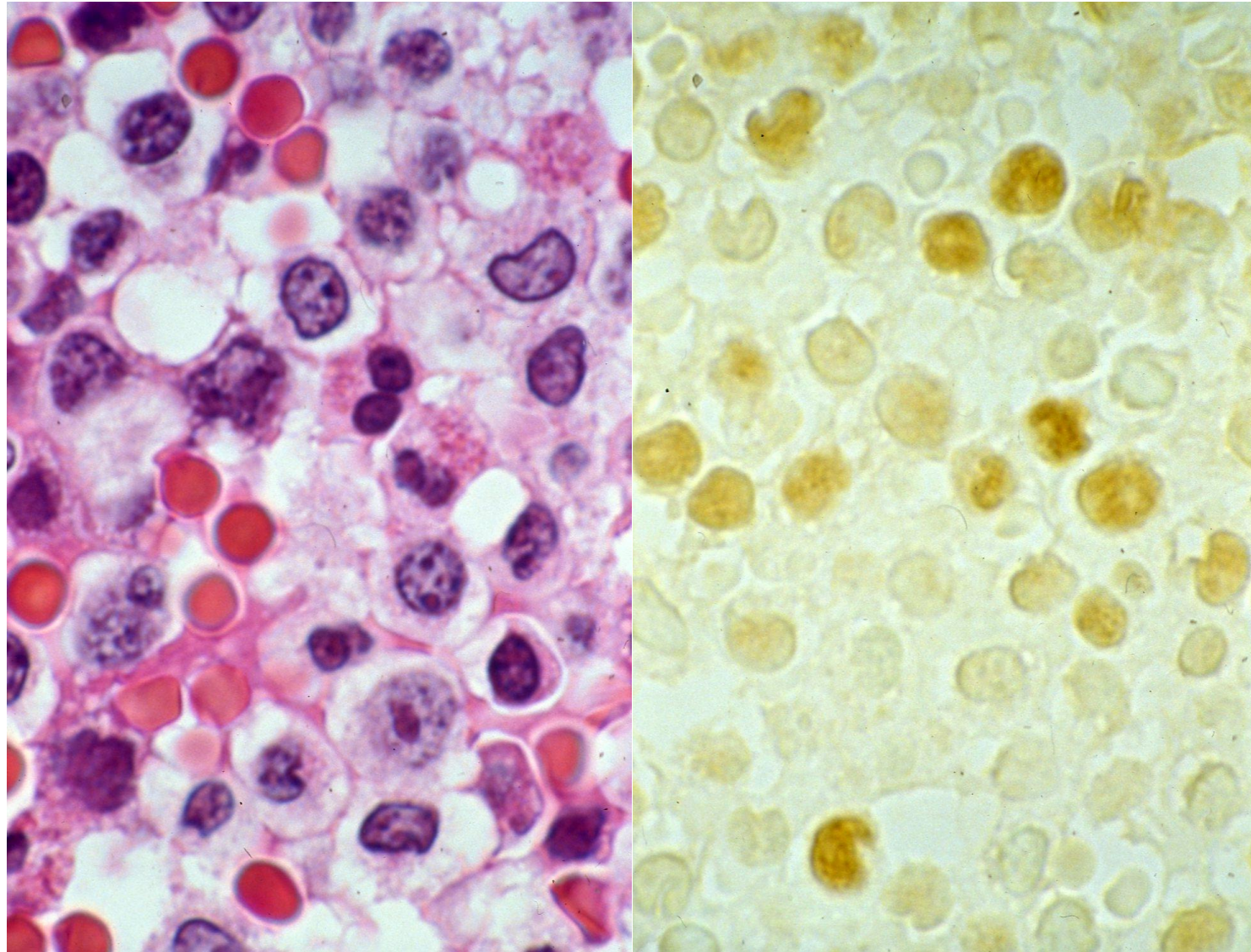
Normal monocyte (left) and plasma cell (right). The monocyte possess an indented nuclei and plump cytoplasm with fine azurophilic granules and vacuoles. The plasma cells possesses a round nucleus with aggregated heterochromatin and basophilic cytoplasm with clear Golgi area. May-Giemsa



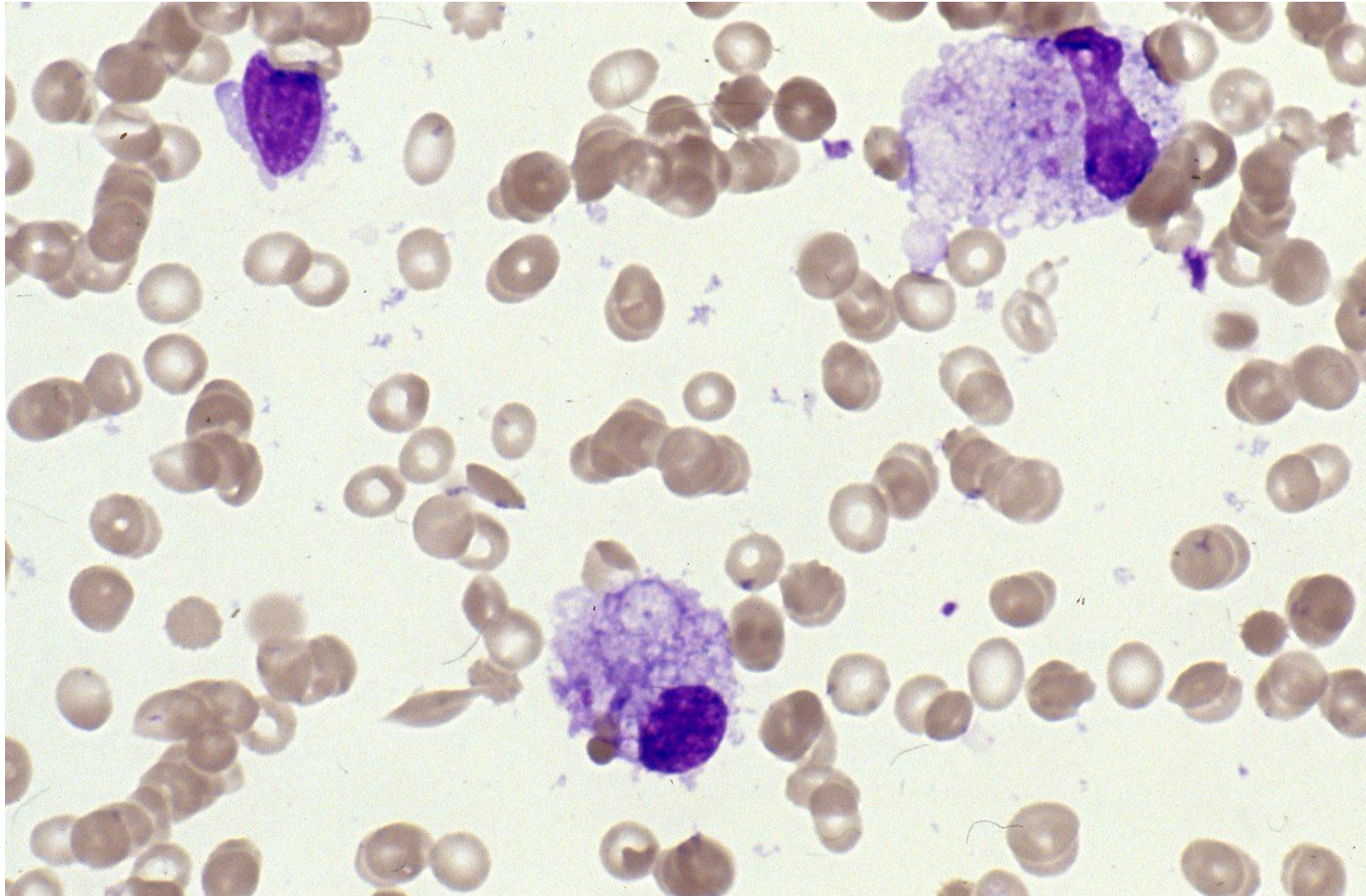
Chronic active EBV infection (1). A young man aged 20's complained of collagen disease-like symptoms with ascites retention. In the aspirated hemorrhagic ascites, numbers of atypical lymphocytes (large granular lymphocytes) and eosinophils are observed. May-Giemsa



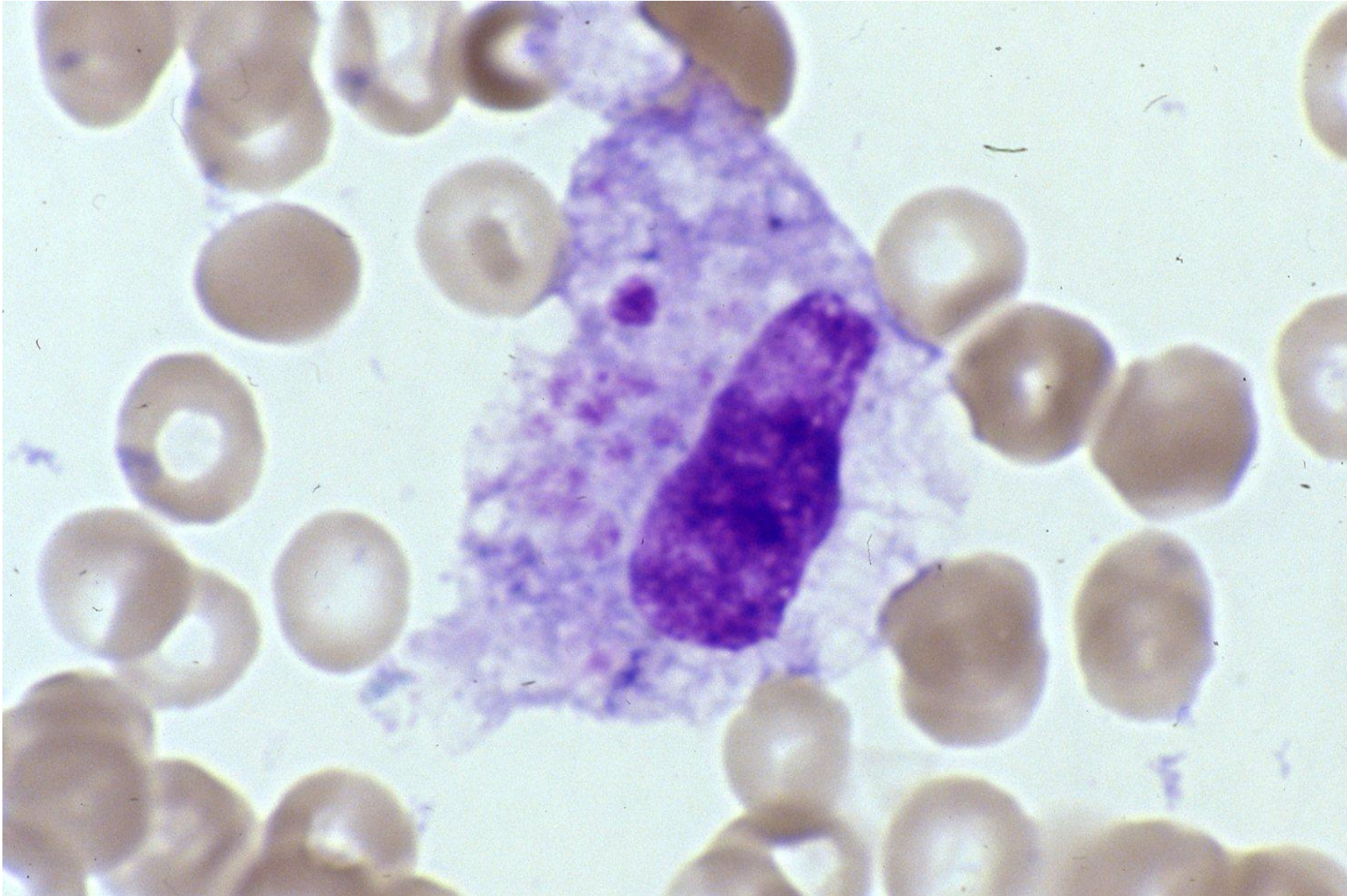
Chronic active EBV infection (2). A young man aged 20's complained of collagen disease-like symptoms with ascites retention. Oil immersion features of atypical lymphocytes (large granular lymphocytes of NK cell origin) reveal azurophilic cytoplasmic granules. May-Giemsa



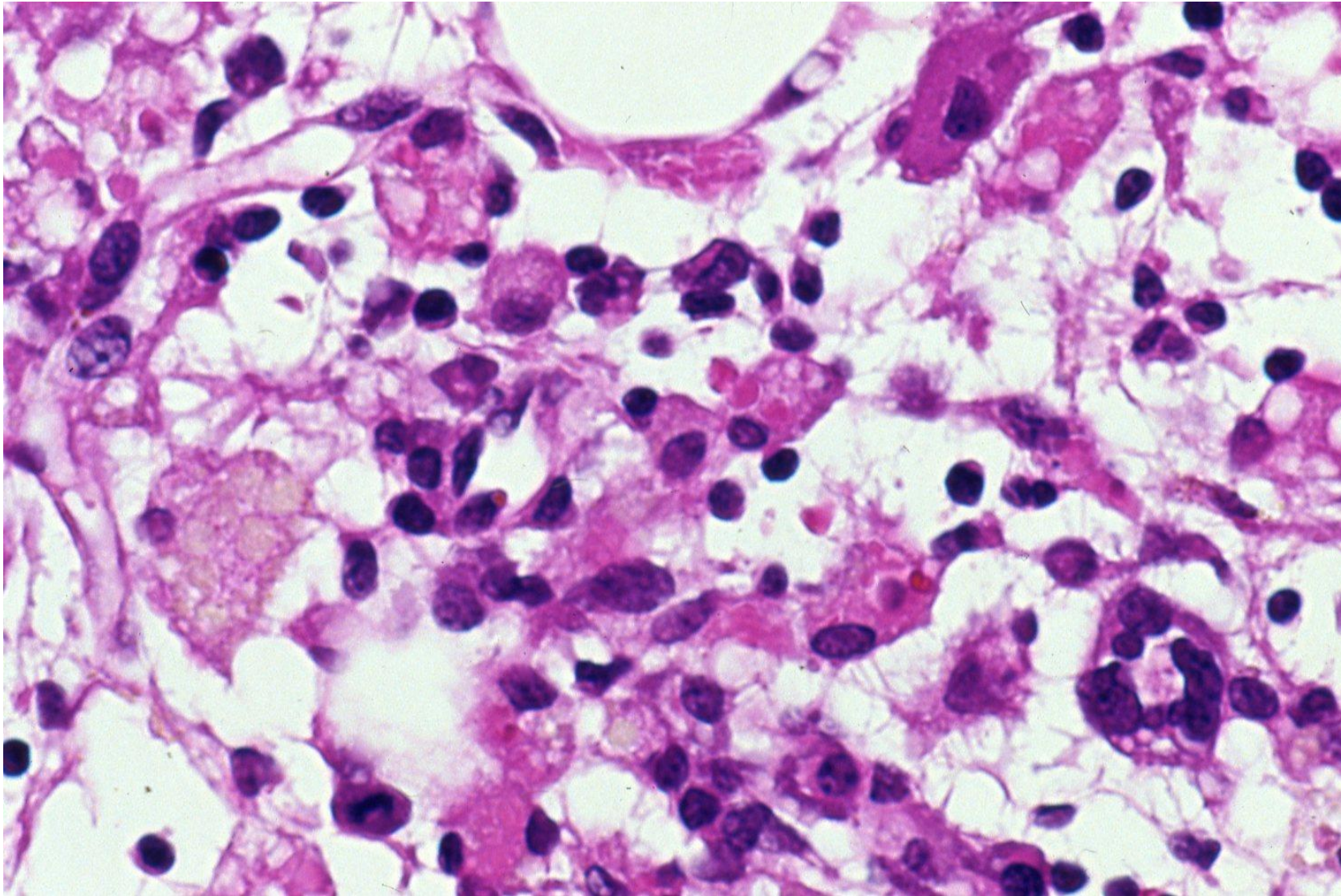
Chronic active EBV infection (3). Cell block preparation (left: H&E, right: EBER). EBER-positive atypical lymphocytes are seen in the background of red blood cells and eosinophils. NK cell nature was confirmed immunohistochemically.



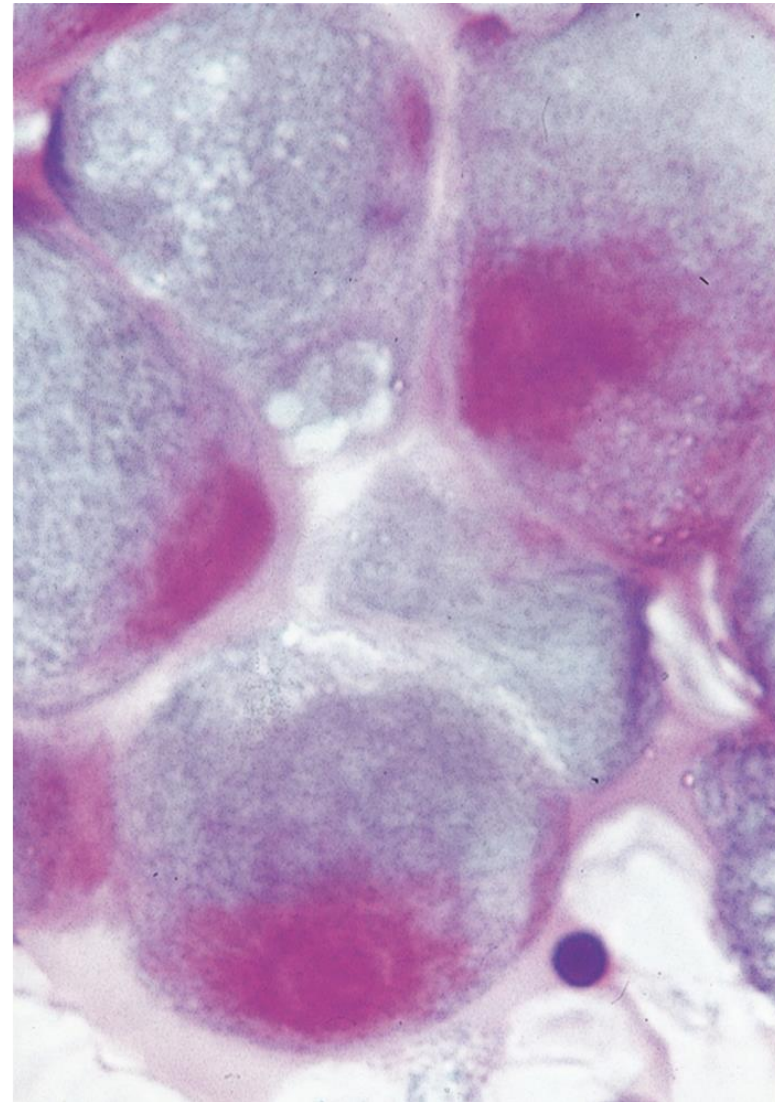
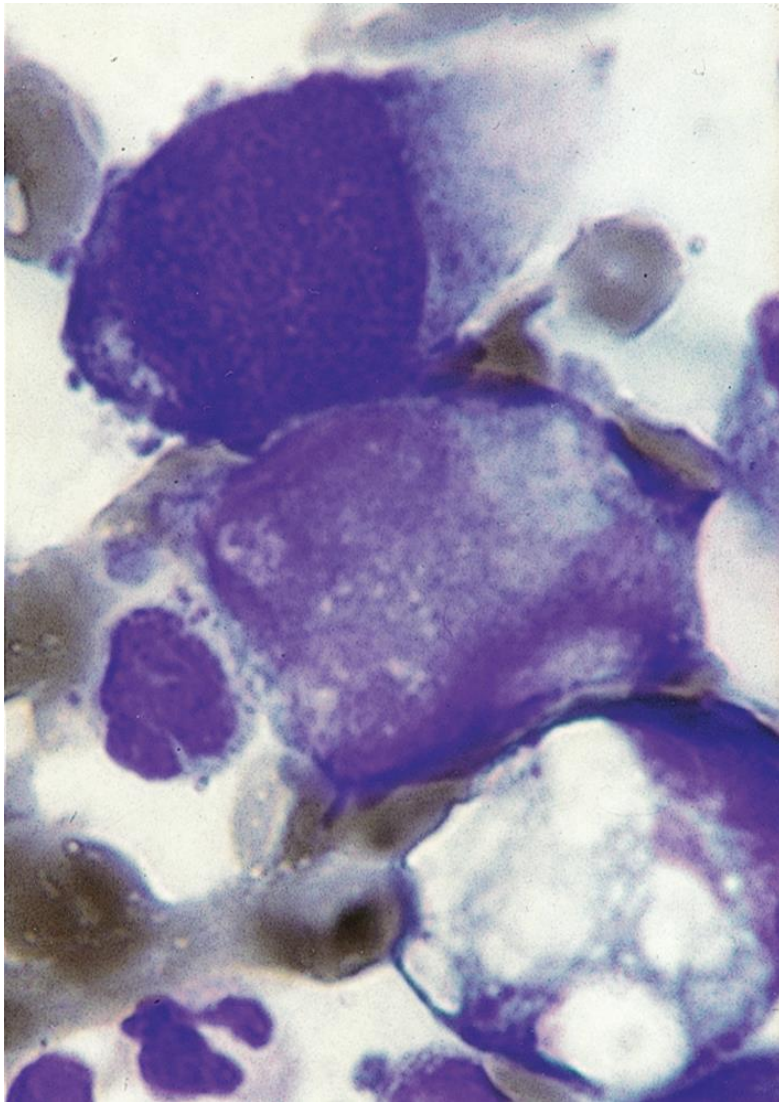
EB-VAHS (Epstein-Barr virus-associated hemophagocytic syndrome) (1). Bone marrow aspiration from a young man aged 20's reveals activated hemophagocytic macrophages. EBER-positive NK cell growth is observed in the lymph node. May-Giemsa



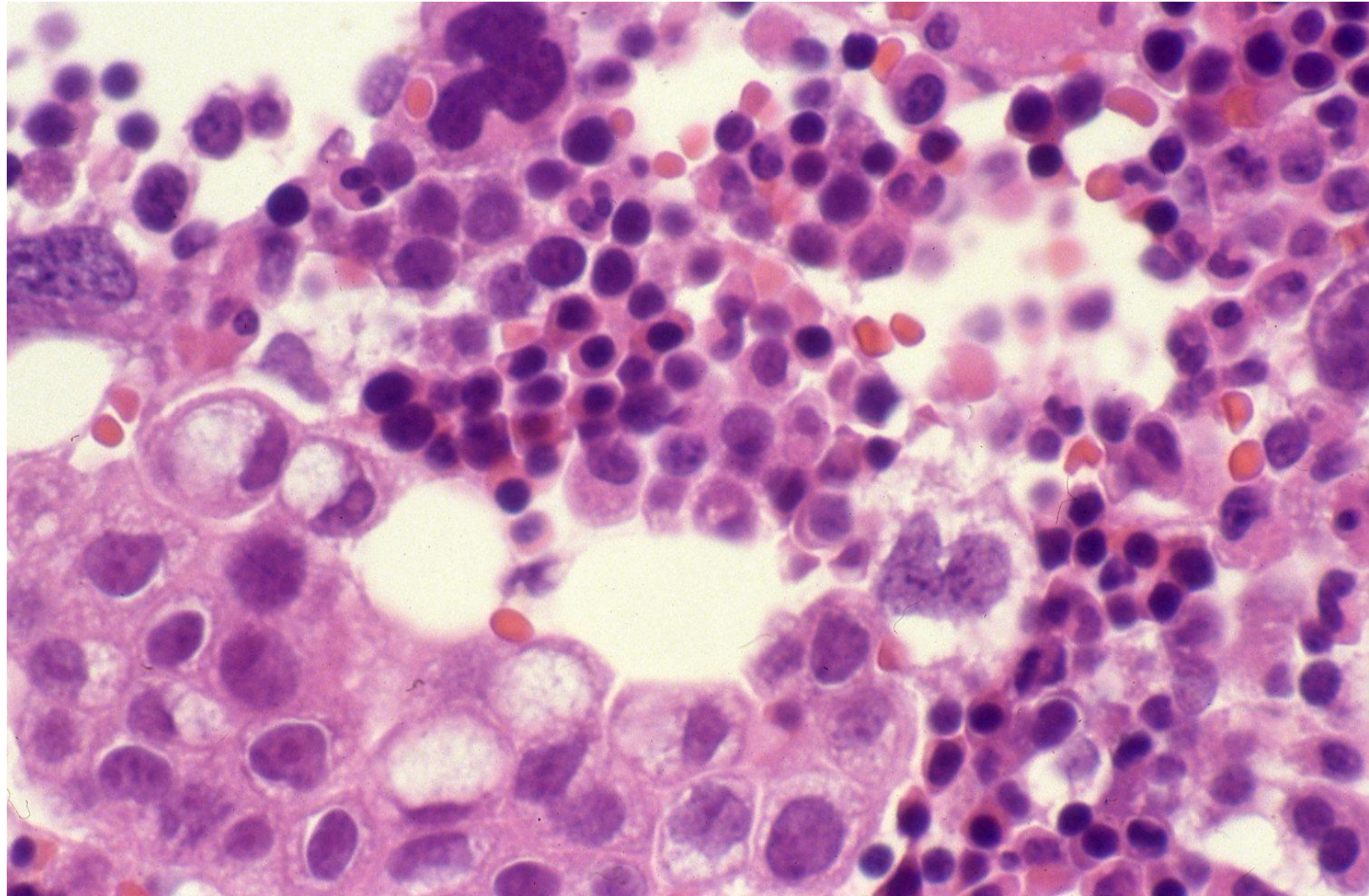
EB-AHS (Epstein-Barr virus-associated hemophagocytic syndrome) (2). Bone marrow aspiration from a young man aged 20's reveals activated hemophagocytic macrophages. Platelets are phagocytized. EBV-positive NK cell growth is observed in the lymph node. May-Giemsa



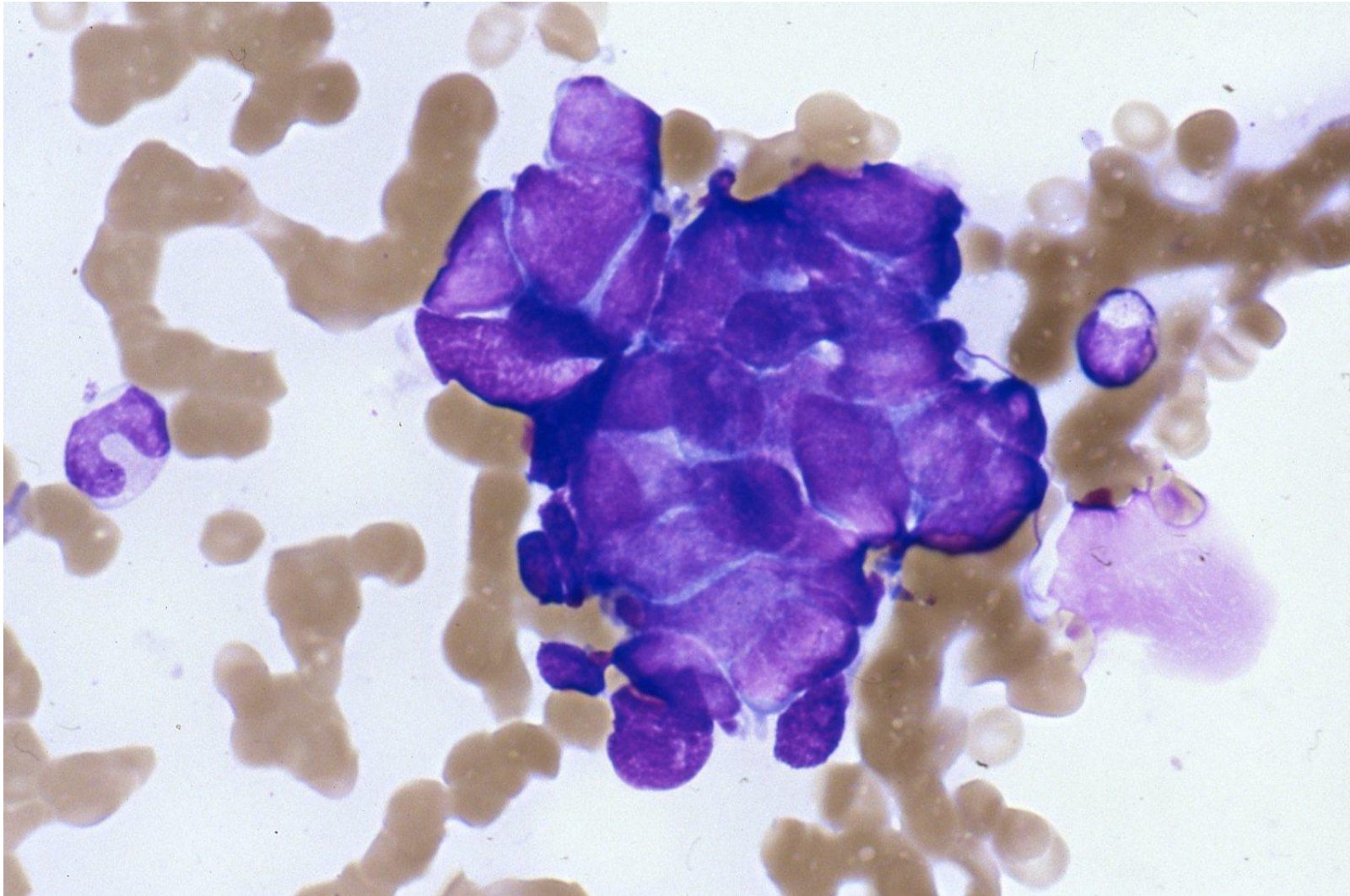
EB-VAHS (Epstein-Barr virus-associated hemophagocytic syndrome) (3). Bone marrow aspiration from a young man aged 20's reveals activated hemophagocytic macrophages. Active erythrophagocytosis is observed. The prognosis is poor. H&E



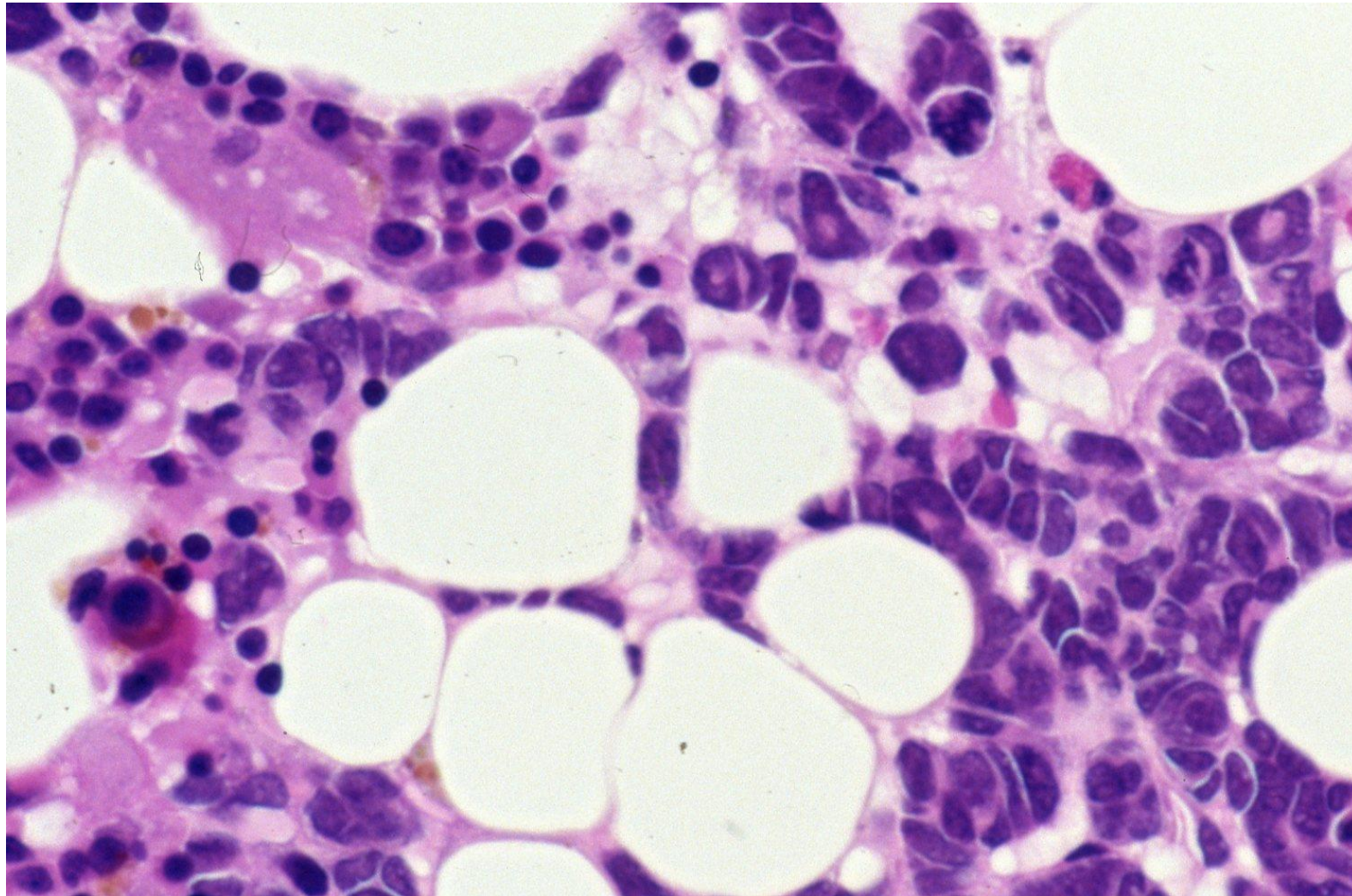
Metastatic signet ring cell carcinoma of the stomach (a 42-year-old man) (1). Left: May-Giemsa, right: PAS. Mucin-containing large-sized signet ring cells are seen in the bone marrow aspiration.



Metastatic signet ring cell carcinoma of the stomach (a 42-year-old man) (2). Mucin-containing large-sized signet ring cells are histologically seen in the bone marrow aspiration. H&E



Metastatic small cell carcinoma of the lung (a 72-year-old man) (1). A cluster of atypical small-sized cells with hyperchromasia and high N/C ratio is seen in the bone marrow aspiration. May-Giemsa



Metastatic small cell carcinoma of the lung (a 72-year-old man) (1). Atypical small-sized cells with hyperchromasia and high N/C ratio occupy the bone marrow space. H&E