EDUCATIONAL COMMENTARY – BLOOD CELL IDENTIFICATION

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Learning Outcomes
Upon completion of this exercise, the participant will be able to:

- Identify morphologic features of normal peripheral blood leukocytes and platelets.
- Describe characteristic morphologic findings in Pelger-Huet cells.
- Distinguish Pelger-Huet cells from other neutrophils on a Wright-stained peripheral blood smear.

The patient presented in the case study for this testing event has a condition called the Pelger-Huet anomaly. The photographs for review represent several types of cells that may be seen in the peripheral blood in this abnormality.

This 35 year old female patient had a routine CBC performed as part of a physical examination. Her CBC data was as follows: WBC=5.6 x 10^9/L, RBC=4.54 x 10^12/L, Hgb=13.5 g/dL, Hct=41%, MCV=90.3 fL, MCH=29.7 pg, MCHC=32.9 g/dL, Platelets=196 x 10^12/L. WBC Differential: Neutrophils=50%, Bands=1%, Lymphocytes=40%, Monocytes=8%, Eosinophils=1%.

Picture BCI-08 shows a normal lymphocyte. Mature lymphocytes are variable in size; this example is considered a small lymphocyte. In such small lymphocytes, the nuclei are relatively large compared to the scanty rim of blue cytoplasm. The nuclei are usually round, oval, or barely indented. The chromatin is clumped, dense, and stains a dark purple.

BCI-09 is a normal eosinophil. This cell is characterized by the numerous red-orange cytoplasmic granules. The nucleus is often bi-lobed in mature eosinophils, as is seen in this example. The chromatin is clumped and stains a deep purple.
The cells depicted in BCI-10 are normal peripheral blood platelets. Technically, platelets are not cells because they have no nuclei. However, they originate from nucleated cells in the bone marrow called megakaryocytes and represent cytoplasmic fragments of these cells. Normal platelets typically vary in size from 1-4 μm in diameter. They are variable in shape, but are most often round or oval. Platelets stain purple or blue-gray. It is difficult to see in this picture, but platelets are granular. The contents of the platelet granules are important in various platelet functions.

BCI-11 illustrates a normal monocyte. Monocytes are large cells, with diameters varying from 15-22 μm. Nuclei in monocytes are variable in shape and may be oval, round, kidney-shaped, or lobulated. Note, this particular cell has a slight indentation. The chromatin is a light pink or purple and is generally fine with minimal clumping. Monocytes have abundant, blue-gray cytoplasm. Vacuoles are often visible. The cytoplasm in monocytes appears rough and uneven. Cytoplasmic projections resembling pseudopods may also be seen. The cytoplasm of monocytes may contain fine pink or lilac (azurophilic) granules, as is seen in this example.

A band neutrophil is shown in BCI-12. These cells are the earliest precursors of neutrophil maturation that can normally be seen in the peripheral blood. Bands are characterized by a nucleus that is shaped like a band, a sausage, or the letters C or U. The chromatin is dense and clumped, as would be expected in a mature cell. The cytoplasm in band neutrophils contains many small, specific granules that stain pink, tan, or violet.
Pictures **BCI-13** and **BCI-14** show examples of 2 types of cells that are representative of the Pelger-Huet anomaly. The Pelger-Huet abnormality is an inherited condition that results in nuclear hypossegmentation of mature neutrophils. Estimates vary, but this autosomal dominant condition may affect as many as 1 out of 5000 individuals. It is a benign anomaly that does not affect the functions of neutrophils. However, the significance of defining the Pelger-Huet condition is in the need to differentiate this benign defect from a shift to the left, described as an increase in immature neutrophils that is commonly associated with infection.

The Pelger-Huet anomaly may be inherited as either a homozygous state or as a heterozygous condition. The homozygous state is very rare and is generally characterized by cells with monolobulated nuclei that appear round or oval. This type of Pelger-Huet cell has been described as the Stodtmeister variant and is depicted in **BCI-13**. This mononuclear variant may also sometimes be associated with heterozygous inheritance. Original work by Petzel and Undritz (1957) noted that the nuclei of the Stodtmeister variants may have notches or protruding filaments. The cell shown in BCI-13 does not appear to have notches or filaments.

Heterozygous Pelger-Huet is characterized by predominantly bi-lobed neutrophils that have been described as having a dumbbell or pince-nez shape. These cells have 2 round lobes that are connected by a single thin filament of chromatin. **BCI-14** is a good example of this classic type of Pelger-Huet cell. Note that both types of Pelger-Huet cells have clumped, course nuclear chromatin and normal-appearing cytoplasmic granulation. The condensed, clumped chromatin in Pelger-Huet cells can help distinguish them from immature cells, such as bands, metamyelocytes, or myelocytes. Also, contrast the cell in BCI-14 to the band neutrophil in BCI-12. Note that the nuclear lobes in the band cells are connected by a bridge of chromatin and are not as symmetrical as those in the Pelger-Huet cell.
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Pelger-Huet type cells may also be seen as an acquired condition associated with myeloproliferative disorders, myelodysplastic syndromes, and leukemias. When seen in such abnormalities, they are called pseudo-Pelger-Huet cells. Pseudo Pelger-Huet cells may have round nuclei with markedly dense chromatin. Sometimes the cells are also hypogranular. Furthermore, in a true Pelger-Huet anomaly, the majority of neutrophils (frequently 70%-90%) will be pelgeroid in appearance. In acquired disorders, normally-segmented neutrophils are more numerous.

Finally, it is also important to note other cells and peripheral blood changes that may help differentiate a Pelger-Huet anomaly from an infection with a left shift or from a pseudo Pelger-Huet condition. Infections may be associated with an elevated white blood cell count and morphologic changes to neutrophils that may include the presence of toxic granulation and Dohle bodies. Conditions that result in pseudo-Pelger-Huet cells may also display morphologic variations in other cells lines, such as erythrocytes.

Suggested Reading

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