Objectives

• Refer to lecture objectives 12-15 on page 56
• Read/refer to pages 67 to 73 in the Hematology Manual as you view the RBC Morphology slides.
  – Focus on identifying characteristics, the general cause and/or the composition of each item shown
  – These RBC abnormalities will be discussed further with the respective disorders/conditions in which they may be found
• All slides are Wright's stained unless otherwise stated.

Erythrocyte Morphology

• The evaluation of RBC morphology is part of a differential
  – Requires careful examination of a well-made Wright's stained blood smear in the correct area
• Five RBC morphologic features are evaluated:
  – Size of the RBCs
  – Color of the RBCs
  – Shape of the RBCs
  – RBC inclusions
  – RBC distribution
• RBC size and color should correlate with the red cell indices

Normal Mature RBC

• Normocytic = normal size, ~7 μ
  – Same size as nucleus of a small lymph; MCV 82-98 fl
• Normochromic = normal color/Hgb content
  – About 1/3 of RBC is empty…pallor area; MCHC 32-36%
• Discocyte - normal RBC survival of 120 days depends upon maintaining RBC shape
  – Must deform…NOT rigid and contains no inclusions

What is the main hemoglobin type in normal RBCs? Hgb A

Abnormal Erythrocyte Morphology

• Significant variations from normal erythrocyte appearance are quantitated or noted on the manual differential report
  – Specific changes in appearance can give CLUES
• When abnormalities are not reported, it is assumed that red cells are normal:
  – Normal RBC morphology is not quantitated/graded, e.g., normocytic or normochromic red cells
  – Comments like 'no significant abnormalities' are reported to infer that red cells appear normal
• During this presentation, normal red cells are shown for comparison

Five RBC morphological features are evaluated on the blood smear:

Variations in RBC Size**
Variations in RBC Color
Variations in RBC Shape
RBC Inclusions
Variations in RBC Distribution/Pattern
Normocytic RBCs, MCV 82.0-98.0 fL

Homogeneous RBC population, low RDW ≤ 14.0%, uniform RBC size

RBC Size Variations - Anisocytosis

Heterogeneous RBC population, high RDW > 14.0%

Variations in RBC Size

Microcytosis (MCV < 82.0 fL)

Macrocytosis (MCV > 98.0 fL)

The red cells shown in A, B and C appear:

A - Macrocytic
B - Microcytic (& hypo)
C - Normocytic

The red cell picture shown demonstrates:

Anisocytosis with microcytic and macrocytic red cells – the RBC population is heterogeneous with a high RDW, aka dimorphic with two RBC populations & the MCV may be falsely normal

Five RBC morphological features are evaluated on the blood smear:

Variations in RBC Size
Variations in RBC Color
Variations in RBC Shape
RBC Inclusions
Variations in RBC Distribution/Pattern
Variations in RBC Size and/or Hgb Content (Color)

Variations in RBC Size
Variations in RBC Color

Five RBC morphological features are evaluated on the blood smear:

Variations in RBC Size
Variations in RBC Color

True or False. Abnormally shaped red cells circulate 120 days.

\[ \text{MCV} = 82-98 \text{ fL} \]
\[ \text{MCHC} = 32-36\% \]

Remember: the MCH value (pg) varies with RBC size and/or Hgb content & tends to parallel the MCV

The red cells shown in A and B exhibit:

\[ \text{MCV} < 82.0 \text{ fL} \]
\[ \text{MCHC} = 32-36\% \]

\[ \text{MCV} > 98.0 \text{ fL} \]
\[ \text{MCHC} = 32-36\% \]

A - Hypochromia
B - Polychromasia

Variations in RBC Shape

Normal Discoid Shape – Deformable Red Cells
Variations in RBC Shape

Poikilocytosis - Abnormal RBC Shape, Rigid RBCs

Spherocytes
Schistocytes

End-stage Liver Disease

Damaged red cells

The red cells at the arrows are:

Acanthocytes – no pallor area
(a spherocyte with projections’)

Echinocytes – Have a pallor

Spherocytes – No pallor

Includes: crenated & burr cells

Acanthocytes – No pallor

Echinocytes – Have a pallor

Spherocytes – No pallor

Includes: crenated & burr cells
Variations in RBC Shape

Target Cells/Codocytes

C Crystals

Sickle Cells/Drepanocytes

Variations in RBC Shape

C crystals → RBCs contain Hgb C

SC crystals → RBCs contain Hgb S & Hgb C

Note that target cells are always present

Sickle Cells → RBCs contain Hgb S

Variations in RBC Shape

The red cells at the arrows are:

a. Sickle cells that contain Hgb S
b. C crystals that contain Hgb C
c. SC crystals that contain Hgb S and Hgb C

c. SC crystals (bizarre shape), ‘confused’

Variations in RBC Shape

Pencil forms – microcytic & hypochromic

Ovalocytes/Elliptocytes

Macrocytic Ovalocytes

Variations in RBC Shape

Five RBC morphological features are evaluated on the blood smear:

Variations in RBC Size
Variations in RBC Color
Variations in RBC Shape
**RBC Inclusions**
Variations in RBC Distribution/Pattern

True or False. RBC inclusions reduce red cell deformability.
RBC Inclusions

A - Diffuse Polychromasia, faint 'dots' versus B - Stippled RBCs, punctate 'dots'

Heinz Bodies, Wright's stain (not visible)

Identify the RBC inclusions at A, B and C

A – Basophilic stippling
B – Howell-Jolly body
C – Pappenheimer bodies

Variations in RBC Size
Variations in RBC Color
Variations in RBC Shape
RBC Inclusions

Five RBC morphological features are evaluated on the blood smear:

Variations in RBC Distribution/Pattern**
Variations in RBC Distribution

- Normal RBC Distribution
- Rouleaux
- RBC Agglutination

Erroneous RBC Morphology due to Artifact

- Precipitated Stain
- Crenated cells due to excess EDTA
- Spherocytes due to poor smear or in wrong area, e.g., on edge

- Oil Artifact