Learning to Decode Your Blood Test Results for CLL

June 29, 2021

10:00 AM PT, 11:00 AM MT, 12:00 PM CT, 1:00 PM ET
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**Welcome:** Patricia Koffman  
Co-Founder and Communications Director  
CLL Society

**Moderator:** Brian Koffman, MDCM (retired), MS Ed  
Executive Vice President and Chief Medical Officer  
CLL Society

**Speaker:** Susan Leclair, PhD, CLS (NCA)  
Chancellor Professor Emerita  
University of Massachusetts Dartmouth
A QUICK RUN DOWN OF ALL 25,000!

- Not really
- But I did want to start off by saying this is a BIG subject and we will only look at a few of the more common tests.

**But first – a word from reality**

Tests live in a real world that is bounded by

<table>
<thead>
<tr>
<th>Preanalytical Aspects</th>
<th>Analytical Aspects</th>
<th>Post-Analytical Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>patient preparation issues</td>
<td>instrumentation</td>
<td>reporting mechanisms (to whom, when)</td>
</tr>
<tr>
<td>time of collection</td>
<td>reagent quality</td>
<td>reflex testing protocols</td>
</tr>
<tr>
<td>conditions of collection</td>
<td>specificity &amp; sensitivity</td>
<td>presence/absence of interpretation</td>
</tr>
<tr>
<td>transport &amp; storage</td>
<td>technique/method</td>
<td>wrong test requested</td>
</tr>
<tr>
<td>confounding meds</td>
<td>location</td>
<td></td>
</tr>
<tr>
<td>wrong test requested</td>
<td>patient population.</td>
<td></td>
</tr>
<tr>
<td>fingerstick vs. venous</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Each of these attributes influences the value of the test result – consistency is key.
WHITE CELL VALUES

- We do not count white cells.
  - We count nuclei so nucleated red blood cells are counted here – corrected white cell count
  - 5 major cell lines present in the peripheral blood
    - Neutrophils – present all the time
    - Lymphocytes – present all the time
    - Monocytes – present occasionally
    - Eosinophils – present occasionally
    - Basophils – present rarely
WHITE CELL VALUES

- The number will bounce around all day long in response to your environment.

  - Want your granulocytes to increase?
    - Exercise (walk up the stairs) for a few minutes before getting your blood drawn
    - Half of your granulocytes usually marginate along the walls of the blood vessels. Exercise “shakes” them off putting them into the circulating pool for about 15-20 minutes.
    - Have a panic attack – reaction to stress
      - Adrenaline will also take cells away from the marginating pool
    - Be on Steroids
WHITE CELL VALUES

- Two ways to report white cells by type

  - Circa 1900 – the traditional differential
    - Look at the first 100 random white blood cells you see using a microscope and your own trained eyes.
    - Some people are better than others
    - Some days and better than others
    - If there are 7500 white cells in a microliter of blood and you count 100 of them - report in percentages
      - What are the odds that you will find what is important?
      - How can you tell which cell line is increased or decreased?

  - Circa – 1980s with the advent of multi-channel instruments
    - Counts the exact number of cells in a specific volume of blood.
    - Count somewhere between 20,000 and 50,000
### WHITE CELL VALUES

- **The best differential is the ABSOLUTE differential.**
  - Counts the exact number of cells in a specific volume of blood.
  - Percentages cannot tell which cell line is increased or decreased.

<table>
<thead>
<tr>
<th>White cell count</th>
<th>% neutrophils</th>
<th>% lymphocytes</th>
<th>A.N.C. Absolute neutrophil Count</th>
<th>A.L.C. Absolute lymphocyte count</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0x10⁹/L</td>
<td>63</td>
<td>37</td>
<td>1.2x10⁹/L</td>
<td>0.74x10⁹/L</td>
</tr>
<tr>
<td>4.0x10⁹/L</td>
<td>63</td>
<td>37</td>
<td>2.5x10⁹/L</td>
<td>1.4x10⁹/L</td>
</tr>
<tr>
<td>8.0x10⁹/L</td>
<td>63</td>
<td>37</td>
<td>5.0x10⁹/L</td>
<td>2.8x10⁹/L</td>
</tr>
<tr>
<td>16.0x10⁹/L</td>
<td>63</td>
<td>37</td>
<td>10.0x10⁹/L</td>
<td>3.7x10⁹/L</td>
</tr>
</tbody>
</table>
WHITE CELL VALUES

- Then why use both?

  - Absolute
    - You get a real number of cells by cell line. And there is NO way to confuse which cell line is increased/decreased

  - Percentage
    - There is nothing better to assess the quality of the cells than having someone who knows what they are doing look at them.

- So doing both gives you a more complete picture of the cells and what they have been doing
WHITE CELL VALUES

- For example
- Both of these are the same cell. One is exhausted and on the brink of death itself. No instrument can tell them apart.
WHITE CELL VALUES

- Is anyone better than another?
  - Neutrophils (once known as granulocytes)
    - Most common cell
    - Exists in the marrow, the two pools in the peripheral blood and in the tissues
    - Phagocytize dead/dying cells and any foreign item (particle or droplet)
    - Incites, controls, and participates in the inflammatory process
    - Determines acute or chronic inflammation
    - Most varied morphology
WHITE CELL VALUES

- Is anyone better than another?
  - Neutrophils (once known as granulocytes)
    - Fully functional
      - Polys, segs, PMNs, bands
      - Seen in peripheral blood
    - Minimally functional
      - Metamyelocytes (Meta) and myelocytes (Myelo)
      - Should not be seen in peripheral blood
    - Not functional
      - Promyelocyte (Pro) and Myeloblast (Blast)
      - Must not be seen in peripheral blood
WHITE CELL VALUES

- Is anyone better than another?
  - Monocytes
    - Usually found in the tissues – uses blood stream to move from one place to another
    - Exists in the marrow, only one pool in the peripheral blood and in the tissues
    - Phagocytize dead/dying cells and any foreign item (particles only)
    - Processes antigens for the T cell to recognize
    - Will be increased after any trauma
WHITE CELL VALUES

- Is anyone better than another?
  - Lymphocytes
    - Found in lymph nodes, lymphatics, peripheral blood, and bone marrow
    - Circulate freely between the nodes/lymphatics and the peripheral blood/marrow
    - Cannot be differentiated using light microscopy
    - Could comment on size (small, medium, large)
    - Assumed an unusual looking lymphocytes WAS damaged in some fashion (atypical)

  - Did not have a known function until the mid 1960s (Robert Good – Minnesota – Nobel Prize)
  - Were separated by function – T, B, and NK cells
  - Realized that “atypical” cells were in fact reacting to the presence of a foreign antigen and were defenders not the illness – new Name Reactive Lymphocytes
    - Sadly – many people refuse to update to the correct name – apathy?
WHITE CELL VALUES

- **Lymphocytes**
  - **Small lymphocytes**
    - Usually B cells
    - Resting from any action so can be naïve or memory
  - **Medium lymphocytes**
    - Can be T, B or NK cells
    - If it has granules, more likely to be T or NK
  - **Large lymphocytes**
    - Can be T or NK
  - **Reactive lymphocyte**
    - If B cell, than larger cytoplasm for antibody production
    - If T or NK cell, less cytoplasm and more granules
WHITE CELL VALUES

- Smudge cell
  - Can be any cell line
  - Usually
    - A cell that is very fragile and cannot withstand the collection and processing.
      - Frequently seen in CLL
    - A cell that has died in the course of some reaction/inflammatory response etc.
      - If a monocyte or neutrophil, can just have died if in a circle.
      - If a neutrophil, then it is called a neutrophil trap or net. The cell has exploded itself in order to make the largest area filled with protein breaking or killing enzymes.
PLATELETS

- The number will bounce around all day long in response to your environment.
  - When performed manually – very difficult so the accepted range is +/- 50,000.
  - When performed by instrument, the accepted range is = +/- 20,000

- As the instruments got better, the acceptable range has moved from 150 – 500 to 150 – 450 to 130 – 400 to even smaller ranges for some facilities (150 – 350)
PLATELETS

- PDW – platelet distribution width
  - Similar to the RDW
  - Mathematical description of size variation
  - Do we care?
    - Partially
      - Larger platelets suggest some type of inflammation, overuse, or drug response
      - Smaller platelets suggest deficiencies similar to microcytic red cells (iron, B₆, hypothyroidism)
  - Why not?
    - The most important things about platelets is their function. We have a few, not very precise tests for platelets because their function is in such a complex situation we cannot replicate it – size of capillary damage, type of damage (smooth vs. ragged), integrity of vessel walls, signaling from localized cells, eternal conditions (heat/cold, pressure, etc.)
PLATELETS

- Bone marrow cell – megakaryocyte, get larger and then breaks off pieces of the cytoplasm
  - Those pieces then need to reorganize themselves
  - Large platelets are usually not well organized and function less efficiently
PLATELETS

- When not stimulated
  - Platelets are small disc shaped pieces of cytoplasm
  - When stimulated, they wring themselves out like a sponge, spreading contents into the area.
    - Their protrusions interlace forming a lattice structure.
    - They ADHERE to damaged walls.
    - Once “laced” they AGGREGATE and tighten
    - Other Contents are stimulants for the clotting process.

- Platelet lack or lessened function is seen in
  - Small blood vessel bleeding (gums, mucous membranes, skin, etc.
  - Not big clots

- Drugs – aspirin, clopidogrel, ticagrelor, ticlopidine
PLATELETS

- Anti-Platelet Drugs
  - Aspirin usually low dose (81mg) but can be 325mg.
  - Clopidogrel – Plavix
  - Ticagrelor – Brilinta
  - Prasugrel (Effient)
  - Dipyridamole/aspirin (Aggrenox)
  - Ticlopidine (Ticlid)
  - Eptifibatide (Integrilin)
Normal Lab Values

Find Information on CLLSOCIETY.ORG

<table>
<thead>
<tr>
<th>Chronic Lymphocytic Leukemia Toolbox</th>
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<td>Ask The Doctor</td>
</tr>
<tr>
<td>Ask The Pharmacist</td>
</tr>
<tr>
<td>Ask The Laboratory Scientist</td>
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<tr>
<td>Ask the Palliative Care/Hospice Doctor</td>
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<tr>
<td>Ask the RN</td>
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<td>Build-A-Team</td>
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<td>CLL Doctors</td>
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<td>CLL Glossary</td>
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<td>CLL Links</td>
</tr>
<tr>
<td>Keeping Track Of Lab Results</td>
</tr>
<tr>
<td>Normal Lab Values</td>
</tr>
</tbody>
</table>

Normal values will vary from lab to lab.
# Normal Lab Values

## Complete Blood Count (CBC)

<table>
<thead>
<tr>
<th>Test Acronym</th>
<th>Meaning</th>
<th>Normal Range Values (Male)</th>
<th>Normal Range Values (Female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>Number of white blood cells</td>
<td>3.5-10.5 x 10⁹/L</td>
<td>3.5-10.5 x 10⁹/L</td>
</tr>
<tr>
<td>RBC</td>
<td>Number of red blood cells</td>
<td>4.7 to 6.1 million cells/mcL</td>
<td>4.2 to 5.4 million cells/mcL</td>
</tr>
<tr>
<td>HGB</td>
<td>Hemoglobin level</td>
<td>13.8-17.2 g/dL</td>
<td>12.1-15.1 g/dL</td>
</tr>
<tr>
<td>HCT</td>
<td>Hematocrit</td>
<td>40.7-50.3%</td>
<td>36.1-44.3%</td>
</tr>
<tr>
<td>MCV</td>
<td>Mean corpuscular volume</td>
<td>80-100 fL</td>
<td>80-100 fL</td>
</tr>
<tr>
<td>MCH</td>
<td>Mean corpuscular hemoglobin</td>
<td>27-31 pg</td>
<td>27-31 pg</td>
</tr>
<tr>
<td>MCHC</td>
<td>Mean corpuscular hemoglobin concentration</td>
<td>32-36 g/dL</td>
<td>32-36 g/dL</td>
</tr>
<tr>
<td>RDW</td>
<td>Red cell distribution width</td>
<td>11.8-15.6%</td>
<td>11.9-15.5%</td>
</tr>
<tr>
<td>PLT</td>
<td>Number of platelets</td>
<td>150-450 x 10⁹/L</td>
<td>150-450 x 10⁹/L</td>
</tr>
</tbody>
</table>
# Normal Lab Values

## White Blood Cell Differential (Diff)

<table>
<thead>
<tr>
<th>Test</th>
<th>Meaning</th>
<th>Normal Range Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuts.%</td>
<td>Percentage of Neutrophils</td>
<td>40% to 60%</td>
</tr>
<tr>
<td>Lymphs%</td>
<td>Percentage of Lymphocytes</td>
<td>20% to 40%</td>
</tr>
<tr>
<td>Monos.%</td>
<td>Percentage of Monocytes</td>
<td>2% to 8%</td>
</tr>
<tr>
<td>Eos.%</td>
<td>Percentage of Eosinophils</td>
<td>1% to 4%</td>
</tr>
<tr>
<td>Baso.%</td>
<td>Percentage of Basophils</td>
<td>0.5% to 1%</td>
</tr>
<tr>
<td>Neuts.# (ANC)</td>
<td>Absolute Neutrophil Count</td>
<td>1.70-7.00 x 10^9/L</td>
</tr>
<tr>
<td>Lymphs# (ALC)</td>
<td>Absolute Lymphocyte Count</td>
<td>1.00-4.80 x 10^9/L</td>
</tr>
<tr>
<td>Monos#</td>
<td>Number of Monocytes</td>
<td>0.30-0.90 x 10^9/L</td>
</tr>
<tr>
<td>Eos#</td>
<td>Number of Eosinophils</td>
<td>0.05-0.50 x 10^9/L</td>
</tr>
<tr>
<td>Baso#</td>
<td>Number of Basophils</td>
<td>0.00-0.30 x 10^9/L</td>
</tr>
</tbody>
</table>
Keeping Track of Your Lab Results

Download the Template to Keep Track of Your Lab History
Keeping Track of Your Lab Results

Allows for a broader view of your long-term *trending* history for all key CLL lab components (CBC, Absolute Lymphocytes, and more)
# Example Lab Tracking Form

**CBC Information**

<table>
<thead>
<tr>
<th>Date</th>
<th>Date</th>
<th>WBC</th>
<th>RBC</th>
<th>HGB</th>
<th>HCT</th>
<th>Platelets</th>
<th>Percent Lymphs</th>
<th>Absolute Lymphs</th>
<th>Percent Neuts</th>
<th>Absolute Neuts</th>
<th>MCV</th>
<th>MCH</th>
<th>MCHC</th>
<th>RDW</th>
<th>MPV</th>
<th>NOTES</th>
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</thead>
<tbody>
<tr>
<td>1/1/15</td>
<td>5.5</td>
<td>4.2</td>
<td>12.1</td>
<td>36.0</td>
<td>150.0</td>
<td>28.0%</td>
<td>0.85-4.1</td>
<td>1.5</td>
<td>28.0%</td>
<td>5.5</td>
<td>80.0</td>
<td>28.0</td>
<td>81.0</td>
<td>32.0</td>
<td>11.0</td>
<td>7.5</td>
</tr>
<tr>
<td>5/1/15</td>
<td>6.0</td>
<td>7.0</td>
<td>18.0</td>
<td>50.0</td>
<td>154.0</td>
<td>60.0%</td>
<td>0.90</td>
<td>3.0</td>
<td>26.0%</td>
<td>30.0</td>
<td>82.0</td>
<td>33.0</td>
<td>37.0</td>
<td>37.0</td>
<td>20.0</td>
<td>11.0</td>
</tr>
<tr>
<td>1/1/16</td>
<td>7.6</td>
<td>6.0</td>
<td>15.0</td>
<td>45.0</td>
<td>170.0</td>
<td>40.0%</td>
<td>0.95</td>
<td>4.2</td>
<td>25.0%</td>
<td>42.0</td>
<td>81.5</td>
<td>28.0</td>
<td>32.0</td>
<td>32.0</td>
<td>11.0</td>
<td>7.5</td>
</tr>
<tr>
<td>5/1/16</td>
<td>5.5</td>
<td>4.2</td>
<td>12.1</td>
<td>36.0</td>
<td>155.0</td>
<td>28.0%</td>
<td>1</td>
<td>3.0</td>
<td>25.0%</td>
<td>3.0</td>
<td>81.0</td>
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<td>37.0</td>
<td>37.0</td>
<td>11.0</td>
<td>8.4</td>
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<tr>
<td>1/1/17</td>
<td>11.0</td>
<td>7.0</td>
<td>18.0</td>
<td>50.0</td>
<td>160.0</td>
<td>60.0%</td>
<td>0.9</td>
<td>1.5</td>
<td>27.0%</td>
<td>1.5</td>
<td>80.0</td>
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<td>34.3</td>
<td>12.0</td>
<td>8.6</td>
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<tr>
<td>5/1/17</td>
<td>9.0</td>
<td>6.0</td>
<td>15.0</td>
<td>45.0</td>
<td>220.0</td>
<td>40.0%</td>
<td>2.15</td>
<td>1.5</td>
<td>26.0%</td>
<td>2.15</td>
<td>82.0</td>
<td>33.2</td>
<td>36.0</td>
<td>36.0</td>
<td>13.4</td>
<td>9.2</td>
</tr>
<tr>
<td>1/1/18</td>
<td>5.5</td>
<td>4.2</td>
<td>12.1</td>
<td>36.0</td>
<td>235.0</td>
<td>28.0%</td>
<td>2.15</td>
<td>2.15</td>
<td>28.0%</td>
<td>3.2</td>
<td>83.0</td>
<td>28.0</td>
<td>42.0</td>
<td>42.0</td>
<td>11.0</td>
<td>7.5</td>
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<td>5/1/18</td>
<td>11.0</td>
<td>7.0</td>
<td>18.0</td>
<td>50.0</td>
<td>215.0</td>
<td>60.0%</td>
<td>3.10</td>
<td>3.4</td>
<td>30.0%</td>
<td>3.4</td>
<td>84.5</td>
<td>33.1</td>
<td>35.7</td>
<td>14.0</td>
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<td>320.0</td>
<td>40.0%</td>
<td>3.15</td>
<td>4.4</td>
<td>31.0%</td>
<td>4.4</td>
<td>92.0</td>
<td>32.4</td>
<td>37.3</td>
<td>12.4</td>
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<td></td>
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<tr>
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<td>5.5</td>
<td>4.2</td>
<td>12.1</td>
<td>36.0</td>
<td>220.0</td>
<td>28.0%</td>
<td>2.99</td>
<td>4.2</td>
<td>32.0%</td>
<td>4.2</td>
<td>81.0</td>
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<td>34.0</td>
<td>34.0</td>
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<td>9.9</td>
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<tr>
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<td>7.0</td>
<td>18.0</td>
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<td>245.0</td>
<td>60.0%</td>
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<td>28.5%</td>
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<td>84.2</td>
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<td>7/1/20</td>
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<td>45.0</td>
<td>280.0</td>
<td>40.0%</td>
<td>3.98</td>
<td>5.1</td>
<td>33.0%</td>
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<td>82.0</td>
<td>29.4</td>
<td>33.0</td>
<td>12.2</td>
<td>8.7</td>
<td></td>
</tr>
</tbody>
</table>
Audience Questions & Answers
This program was made possible by grant support from

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Thank You for Attending!

Please take a moment to complete our post-event survey, your feedback is important to us.

Join us in August for our webinar on **PI3K Inhibitors**

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