

(9/11) 7: Blood Lab Values

Monday, September 15, 2014
2:05 PM

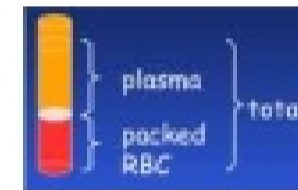
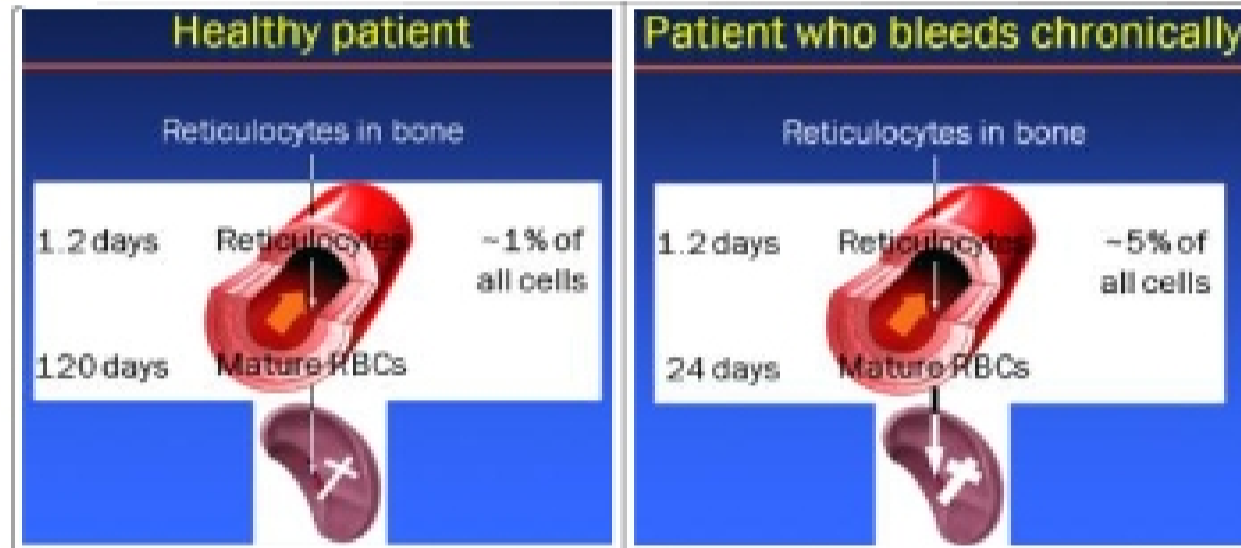
Topics:

- What is the CBC (complete blood count)?
- pH, CO₂/HCO₃⁻ as an H⁺-buffer

Learning Objectives:

- Explain how the hematocrit, 'hemoglobin' (in g/dl), and the red blood cell count relate to each other.
- Explain the relationship between the mean corpuscular hemoglobin concentration (MCHC) and the terms hypochromia, normochromia, and hyperchromia.
- Interpret an elevated reticulocyte count.
- List abnormal lab values that you would expect to see in a patient who has an iron deficiency anemia.
- Interpret an elevated RDW
- Use the H-H equation to calculate pH or a ratio of protonated/unprotonated molecules

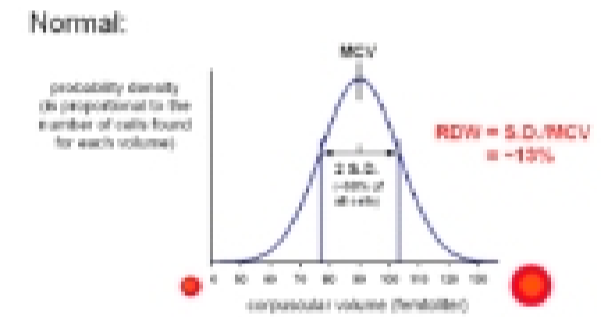
RETICULOCYTE COUNT- reticulocytes in blood (used to be counted by staining mRNA) (NORMAL= 1%)



CBC- parameters related to RBCs

- Crit - RBC/Total Blood Volume (used to be measured in capillary, now calculated from RBC # & RBC Blood Volume) (NORMAL= 45%)
 - BLOOD DOPING - must be ≤ 50%
- [Hb] - 4 subunits (NORMAL= 15 g/dL)
 - HEME - absorbs light
 - HEMOCUE HEMOGLOBINOMETER - light shines through blood to measure [Hb]
- MCH - amount of Hb per cell (NORMAL= 30pg) Crit = Hb x 3
- [MCHC] - [Hb] per cell (NORMAL= 34 g/dL)

- HYPOCHROMIC	low MCHC		microcytes (↓ Hb) & macrocytes (↑ volume)
- NORMOCHROMIC	MCHC = 34 g/dL		
- HYPERCHROMIC	high MCHC		



- [RBC#] - concentration of RBC (NORMAL = 5million/uL)
- MCV - volume of RBC (NORMAL = 90fL)
 - **MICROCYTIC**: MCV < 80fL, impaired Hb synthesis
 - **NORMOCYTIC**: MCV = 90fL
 - **MACROCYTIC**: MCV > 100fL, impaired DNA replication
- RDW = SD/MCV *we are worried about RDW increasing (meaning wide range of sizes)* (NORMAL= 13%)
 - **IRON DEFICIENT**- microcytic, ↑ RDW
 - **SICKLE CELL ANEMIA** - variant Hb, ↑ RDW
 - **MEGALOBlastic ANEMIA** - impaired DNA replication, ↑ RDW

ANEMIA (needs 1 of the following):	POLYCYTHEMIA - due to dehydration or malignancy (↓ Epo)
- low Crit	- high Crit
- low RBC #	- high RBC #
- low [Hb]	- high [Hb]
Causes of Anemia:	Causes of Polycythemia:
- ↓ Epo	- ↓ Epo
- ↑ RBC removal	- dehydration

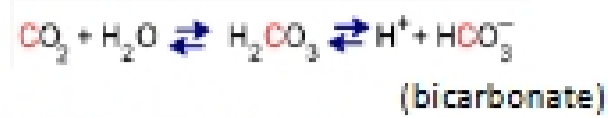
TRANSFUSION - 1 unit RBC, Hematocrit + 3%

LEUKOPENIA - low WBC
LEUKOCYTOSIS - high WBC

SERUM - top layer after blood to clots, free of fibrinogen

CO2- soluble in water (does not require transporter)

1.2mM 24mM



BICARBONATE - main H+ buffer in blood

Henderson-Hasselbalch: $\text{pH} = \text{pK} + \log (\text{HCO}_3^-/\text{CO}_2)$

*at body temp,

$$\text{pH} = 6.1 + \log (24/1.2) = 7.4$$

METABOLIC ACIDOSIS - acid in blood, ↑ H+, reacts with HCO3-, creates excess CO2

Compensation: excess CO2 exhaled to compensate (↓CO2, ↓HCO3-)

IRON = TOXIC!

HAPTOGLOBIN - binds to Hb when RBCs burst, bring to liver for disposal

HEMOPEXIN - binds to Heme when RBCs burst, bring to liver for disposal

Reticulocyte #	Reticulocytes/Total Blood Volume	1%
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Normal Values:

Crit	= RBC Volume /Total Blood Volume	45%
[Hb]	= Hb/Total Blood Volume	15 g/dL
MCH	= Hb per RBC	30pg
[MCHC]	= [Hb] per RBC = [Hb]/Crit	34 g/dL
[RBC #]	= # RBC/Total Blood Volume	5 million/uL
MCV	= RBC Volume	90fL
RDW	= SD/MCV (range of RBC Volumes)	13%

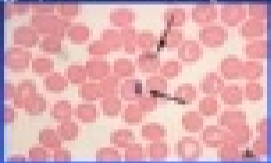
$$\text{Crit} = \text{Hb} \times 3$$

$$\text{pH} = 6.1 + \log (24/1.2)$$

Main Points:

- CBCs are important
- Reticulocyte count reflects RBC production
- Crit, Hb, RBC #: reflect O2 carrying capacity, bleeding, erythropoiesis, etc
- MCV, MCH, MCHC, RDW: describe typical RBC
- CO2 & HCO3- buffer the pH of blood

Sample Questions:

<p>Who wants to be a pharmacist?</p> <p>When health-care providers use the word hematocrit, they refer to which ratio?</p> <p>A hemoglobin/plasma B RBCs/plasma C RBC/whole blood D hemoglobin/RBC</p>	<p>Who wants to be a pharmacist?</p> <p>A reticulocyte count of 5% is an indicator of?</p> <p>A polycythemia B blood loss C slow RBC maturation D renal failure</p>	<p>Who wants to be a pharmacist?</p> <p>In this image, the arrows point to what?</p>  <p>A mature red blood cells B neutrophils C mature white blood cells D reticulocytes</p>
<p>Who wants to be a pharmacist?</p> <p>In the U.S., what is the number of red blood cells in a liter of blood?</p> <p>A 5 trillion B 5 million C 5 billion D 500,000</p>	<p>Who wants to be a pharmacist?</p> <p>A patient with a hematocrit of 30% most likely has a 'hemoglobin' of</p> <p>A 3 g/dl B 10 g/dl C 30 g/dl D 90 g/dl</p>	<p>Who wants to be a pharmacist?</p> <p>A microcytic red blood cell most likely has what?</p> <p>A high MCV B high MCH C low RDW D low MCHC</p>