Akal College of Nursing

Baru Sahib

Class Summary

**Date**: 4/12/15

**Time:** 2 to 3pm

**Class** B.Sc. Nursing IInd Year

**Subject:** Pathology

**Unit:** Clinical Pathology

**Topics:** Blood chemistry

**Blood chemistry**

* CBC (Complete Blood Count)
  + with or without differential
* BMP (Basic Metabolic Panel)
* CMP (Comprehensive Metabolic Panel)
* **Complete blood count**
  + With or without differential
  + Peripheral venous blood is collected in a lavendar tube (contains the anticoagulant EDTA) and should be thoroughly mixed
  + Unacceptable specimen: Clotted or greater than 48 hours old
* Methodology of testing:
  + Whole blood analyzer
* **Red blood cell data**
  + Total red blood cell count (RBC)
  + Hemoglobin (Hgb)
  + Hematocrit (Hct)
  + Mean corpuscular volume (MCV)
  + Red blood cell distribution width (RDW)
* **White blood cell data**
  + Total white blood cell (leukocyte) count (WBC)
  + A white blood cell count differential may also be ordered
* **Platelet Count (PLT)**

**Total Red Blood Cell Count**

* Count of the number of circulating red blood cells in 1mm3 of peripheral venous blood

**Hemoglobin**

* The hemoglobin concentration is a measure of the amount of Hgb in the peripheral blood, which reflects the number of red blood cells in the blood
  + Hgb constitutes over 90% of the red blood cells
* Decrease in Hgb concentration =
  + anemia
* Increase in Hgb concentration =
  + polycythemia

**Hematocrit**

* Hematocrit is a measure of the percentage of the total blood volume that is made up by the red blood cells
* The hematocrit can be determined directly by centrifugation (“spun hematocrit”)
  + The height of the red blood cell column is measured and compared to the column of the whole blood

**Centrifuged blood (normal)**

Normal Hct in adult males

40-54%

Normal Hct in adult females

34-51%

**Calculating the Hematocrit**

* More commonly the Hct is calculated directly from the RBC and MCV
  + Hematocrit % = RBC (cells/liter) x MCV (liter/cell)
  + Because the Hct is a derived value, errors in the RBC or MCV determination will lead to spurious results

**Mean Corpuscular Volume**

* The MCV is a measure of the average volume, or size, of an RBC
* It is determined by the distribution of the red blood cell histogram
  + The mean of the red blood cell distribution histogram is the MCV

**Red Cell Distribution Histogram**

**Use of MCV Result**

* The MCV is important in classifying anemias
  + Normal MCV = normocytic anemia
  + Decreased MCV = microcytic anemia
  + Increased MCV = macrocytic anemia

**Red Blood Cell Distribution Width**

* RDW is an indication of the variation in the RBC size (referred to anisocytosis)
* It is derived from the red blood cell histogram and represents the coefficient of variation of the curve
* In general, an elevated RDW (indicating more variation in the size of RBCs) has been associated with anemias with various deficiencies, such as iron, B12, or folate
* Thalassemia is a microcytic anemia that characteristically has a normal RDW

**White Blood Cell Count**

* A count of the **total** WBC, or leukocyte, count in 1mm3 of peripheral blood
* A decrease in the number of WBCs =
  + Leukopenia
* An increase in the number of WBCs =
  + Leukocytosis

**WBC Differential**

* When a differential is ordered, the percentage of each type of leukocyte present in a specimen is measured.
* Name the types of leukocytes
  + Neutrophils (includes bands)
  + Lymphocytes
  + Monocytes
  + Eosinophils
  + Basophils
* WBC differentials are either performed manually or by an automated instrument

**Platelet Count (PLT)**

* A count of the number of platelets (thrombocytes) per cubic milliliter of blood
  + A decreased number of platelets =
    - Thrombocytopenia
  + An increased number of platelets =
    - Thrombocytosis

**MCH and MCHC**

Both MCH and MCHC are of little clinical diagnostic use in the vast majority of patients (so we did not talk about them in any detail)

* + MCH is the hemoglobin concentration per cell
  + MCHC is the average hemoglobin concentration per total red blood cell volume

**Essentially normal CBC**

WBC, Hgb, Hct, MCV, RDW, PLT count values are all within the normal reference ranges

**Absolute numbers (#) of various cell types are calculated by multiplying the percentage (%) of the white cell by the total WBC.**

For example, there are 39% lymphoctyes.

The total number of WBC is 9,400 (see CBC)

9,400 x 0.39 = 3,666

Therefore, the absolute lynphocyte count is 3.6 K/MM3

**The example of a patient’sCBC is…………………………………**

* CBC demonstrates
  + Leukocytosis
  + Microcytic anemia with elevated red cell distribution width
  + Thrombocytopenia

**BMP**

* The BMP is a chemistry panel where multiple chemistry tests are grouped as a single profile for ease of ordering since this group of tests are often all medically necessary.
* The BMP includes electrolytes and tests of kidney function:
  + Sodium (Na)
  + Potassium (K)
  + Chloride (Cl)
  + Carbon Dioxide Content (CO2)
  + Blood Urea Nitrogen (BUN)
  + Serum Creatinine (Cr)
  + Serum glucose (Glu)
  + Total Calcium (Calcium)
* Peripheral venous blood can be collected in several types of tube
  + **Light Green PST**
    - Plasma separating tube (PST) with the anticoagulant lithium heparin
  + **Gold SST**
    - Serum separating tube (SST) contains a gel at the bottom to separate blood cellular components from serum on centrifugation
  + **Red**
    - No Additives – blood clots and serum is separated by centrifugation

**Sodium**

* Sodium is the major cation in the extracellular space where serum levels of approximately 140mmol/L exist
  + Sodium salts are major determinants of extracellular osmolality.
  + Increased serum sodium level =
  + Hypernatremia
* Decreased serum sodium level =
  + Hyponatremia

**Potassium**

* Potassium is the major intracellular cation with levels of ~ 4 mmol/L found in serum
* Elevated serum potassium level =
  + Hyperkalemia
* Decreased serum potassium level =
  + Hypokalemia

\*note – if a specimen is hemolyzed (such as by traumatic venipuncture or drawing blood with a needle that is too small) potassium levels may be “falsely” elevated. Why?

There are high concentrations of K in red blood cells. If RBCs are lysed during phlebotomy, K is released into the serum resulting in elevated measured levels.

**Chloride**

* Chloride is the major extracellular anion with serum concentration of ~ 100 mmol/L
* Hyperchloremia and hypochloremia are rarely isolated phenomena.
  + Usually they are part of shifts in sodium or bicarbonate to maintain electrical neutrality.

**Carbon Dioxide Content**

* The carbon dioxide content (CO2) measures the H2CO3, dissolved CO2 and bicarbonate ion (HCO3) that exists in the serum.
* Because the amounts of H2CO3 and dissolved CO2 in the serum are so small, the CO2 content is an indirect measure of the HCO3 anion
  + Therefore, clinicians most often refer to the CO2 measurement in the BMP as the “bicarbonate level” or “bicarb level”

**Blood Urea Nitrogen**

* The BUN measures the amount of urea nitrogen in the blood.
  + Urea is formed in the liver as the end product of protein metabolism and is transported to the kidneys for excretion.
  + Nearly all renal diseases can cause an inadequate excretion of urea, which causes the blood concentration to rise above normal.
  + The BUN is interpreted in conjunction with the creatinine test – these tests are referred to as “renal function studies”.

**The creatinine**

* The creatinine test measures the amount of creatinine in the blood.
  + Creatinine is a catabolic product of creatine phosphate used in skeletal muscle contraction.
  + Creatinine, as with blood urea nitrogen, is excreted entirely by the kidneys and blood levels are therefore proportional to renal excretory function.

**Glucose**

* Plasma glucose levels should be evaluated in relation to a patient’s meal
  + i.e., postprandial vs fasting
  + Elevated glucose levels may also be indicative of diabetes mellitus
* Glucose is the most commonly measured test in the laboratory
* Diagnosing Diabetes
* The criteria for the diagnosis of diabetes:
  + Fasting Plasma Glucose ≥126 mg/dL
  + 2 hour Post-Prandial Glucose ≥200 mg/dl
  + Random Plasma Glucose >200 mg/dL in the presence of symptoms
  + Any one of these criteria must be repeated on subsequent testing of a new specimen

**Total Calcium**

* The total serum calcium is a measure of both
  + Free (ionized) calcium
  + Protein bound (usually to albumin) calcium
  + Therefore, the total serum calcium level is affected by changes in serum albumin
  + As a rule of thumb, the total serum calcium level decreases by approximately 0.8mg for every 1gram decrease in the serum albumin level.
* **BMP as reported**
* Component Value Flag Low High Units
* SODIUM 142 136 144 MM/L
* POTASSIUM 3.9 3.3 5.1 MM/L
* CHLORIDE 107 98 108 MM/L
* CO2 27 20 32 MM/L
* BUN 10 7 22 MG/DL
* CREATININE 0.80 0.7 1.5 MG/DL
* GLUCOSE 100 70 100 MG/DL
* CALCIUM 8.5 L 8.9 10.3 MG/DL

Your Interpretation?

* This patient has mild hypocalcemia Submitted by:

Submitted by

Suchpreet Kaur

Clinical instructor

ACN