Clinical Pearls in Laboratory Interpretation: RBC’s, WBC’s and LFT’s

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Relevant Financial Relationship Disclosure Statement

Title of talk

I will not discuss off label use and/or investigational use of any drugs/devices.

I don’t have the following relevant financial relationships to report in relationship to this presentation.

Objectives

Upon completion of this lecture, the participant will be able to:
- Identify a step approach to the interpretation of a cbc – rbc’s and wbc’s; hepatic function tests
- Discuss various laboratory abnormalities identified on an individual throughout the lifespan
- Systematically interpret laboratory findings using case studies
Red Blood Cell Formation

- Formed in bone marrow (erythropoiesis)
- When mature, the rbc is released into circulation
- Mature rbc has a life span of approximately 120 days
  - Many factors trigger an increase in the production of rbc's by the bone marrow, but a decrease in O\textsubscript{2} is the most common.
  - Low tissue oxygen levels trigger the endothelial cells in the kidneys to secrete erythropoietin – which in turn, stimulates bone marrow red cell production

Anemia: Defined

- Anemia — comes from the Greek word "Anaimia" — meaning "without blood"
- A decrease in the number of red blood cells, hemoglobin, or hematocrit
  OR
- A decrease in the oxygen carrying capacity of the blood

Step Approach is Essential
**The CBC - A Blessing or a Curse**

- **RBC**
  - 4.1-5.1 m/mm³

- **Hemoglobin**
  - 12-16 g/dl

- **Hematocrit**
  - 36-46%

**1 hemoglobin : every 3 hematocrit**

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**The Indices - Your Most Important Tools**

- **MCV** - Mean Corpuscular Volume
  - 80 - 100: Normocytic
  - <80: Microcytic: defect in hgb synthesis
  - >100: Macrocytic

  *The MCV allows you to classify the type of anemia to further determine the etiology*

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**MCHC** - Mean Corpuscular Hemoglobin Concentration

- Average concentration of hemoglobin in red blood cells
  - Much more helpful than the MCH
  - Provides you with information regarding the color of the cells

- Normal:
  - 32-37: Normochromic
  - <32: Hypochromic
Classifications/Causes of Anemia

Macrocytic, Normochromic
(↑ MCV, Normal MCHC)
Vitamin B12 Deficiency
Folate Deficiency
Also: Hypothyroidism
Myelodysplastic Process

Classifications/Causes of Anemia

Normocytic, Normochromic
(Normal MCV and Normal MCHC)
Anemia of Chronic Disease
Acute Blood Loss
Early Iron Deficiency

Classifications/Causes of Anemia

Microcytic, Hypochromic
(↓ MCV and ↓ MCHC)
Iron deficiency Anemia
Thalassemia
Lead Poisoning
Sideroblastic Anemia
Aluminum Toxicity
G6PD
(Occasionally: Anemia of Chronic Disease)
**RDW**

- Red Cell Distribution Width
- Normally all red cells are about equal in size
- RDW is the degree of anisocytosis or the variability of the red cell size
- Helps to differentiate between various causes of microcytic, hypochromic anemia
  - IDA, Thalassemia, and Anemia of Chronic Disease
    - Increased RDW - IDA
    - Normal RDW - Anemia of Chronic Disease
    - Normal or slightly increased RDW - Thalassemia

**Reticulocyte Count**

- The number of new, young, red blood cells found in 100 rbc's in circulation
  - It is expressed as a percentage with normal being approximately 1-2%
  - It is an index of the bone marrow's health and response to the anemia

**What Does an Elevated Reticulocyte Count Indicate?**

ELEVATED RETICULOCYTE COUNT MEANS THAT THE BONE MARROW IS HEALTHY and/or YOUR TREATMENT IS WORKING BUT...Blood loss or destruction is likely occurring
Anemia is not a diagnosis; it is a sign of an underlying problem.

Macrocytic Anemia

Vitamin B12 Deficiency
Signs and Symptoms of Pernicious Anemia

- Anemia with elevated MCV
- Smooth and beefy red tongue
  - Tongue is frequently very sore
- Diarrhea
- Anorexia

Neurologic Manifestations

- Neurologic manifestations are related to the inability to maintain myelin integrity
- Paresthesias
  - Pins and needles – stocking/glove distribution
  - Weakness in extremities
- Delirium/psychosis may occur
- Decreased position and vibratory sense
- Incoordination
- Depression

Diagnosis of Pernicious Anemia

- CBC
- Peripheral smear
- Vitamin B12 level
- Schilling test
  - This test will confirm that the Vitamin B12 deficiency is caused by an intestinal malabsorption due to a deficiency in the intrinsic factor rather than other malabsorptive conditions
Folate Deficiency

Clinical Presentation
- May be asymptomatic
- Glossitis
- Similar presentation to vitamin B12, when severe

Diagnosis
- Serum folate level
- Additional tests
  - MMA (methylmalonic acid)
  - Homocysteine (Hcy)
  - Both will be elevated in vitamin B12 deficiency
  - Only homocysteine will be elevated in folate deficiency
Treatment of Vitamin B12 or Folic Acid Deficiency

- If anemia fails to resolve, remember IDA coexists in 1/3 of patients with these types of anemia

Microcytic Anemia

Iron Deficiency Anemia

Blood loss is the number ONE cause for IDA in individuals > 4
Diagnosis of Iron Deficiency Anemia

- Ferritin
  - Measurement of iron stores
  - Level < 16 is diagnostic of IDA
  - Normal: 10 - 210
  - Keep in mind that this can be falsely elevated in the individual with febrile illness, malignancy, liver disease, inflammatory diseases
- Iron
  - Normal: 50 - 160
  - Amount of circulating iron
  - Low level coupled with an elevated TIBC is suggestive of IDA

Diagnosis of Iron Deficiency Anemia

- TIBC
  - Normal: 250 - 350
  - Number of cells not bound with iron
  - Higher the iron, lower the TIBC
  - Lower the iron, higher the TIBC
- Peripheral Blood Smear
  - Anisocytosis
  - Poikilocytosis
  - Microcytosis, hypochromia

Red Cell Morphology

- Spherocyte – hereditary condition; hemolytic anemia
- Schistocyte – prosthetic heart valve
- Elliptocyte or ovalocyte – iron deficiency anemia
- Teardrop cells – iron deficiency anemia
- Sickle cells – sickle cell disease
- Target cells – thalassemia
- Basophilic stippling – Thalassemia, lead toxicity
- Bite cells – G6PD deficiency
Normocytic Anemia

Chronic Disease
- Frequently accompanies chronic disorders
  - Acute and chronic infections
  - Malignancy
  - Inflammatory disorders
  - HIV disease
- Hypoproliferative state
- Commonly confused with iron deficiency

Pathophysiology
- Usually caused when there is a trapping of iron by macrophages
- Renders iron unavailable for erythropoiesis
- Inflammatory processes also suppress erythropoiesis leading to diminished production of rbc's
Clinical Presentation

- Asymptomatic
- Fatigue
- Tachycardia
- Pallor
- Similar presentation to an IDA

Laboratory Diagnosis

- Anemia – Normal MCV, normal MCHC
- Rarely will the hematocrit go below 25% with an ACD
- Serum iron is often low
- TIBC is also often low – differentiates it from IDA
- Ferritin will be normal or even increased – very helpful to differentiate ACD from early IDA

Case - 1

86 year old woman in for a complete physical.
Labs:  wbc 7.1, rbc 4.64, hgb 8.8, hct 28.1, MCV 84, MCHC 32.8, RDW 13.0, normal diff.
What type of anemia?
What would you order?
IL – 69 year old male

- Presents with complaints of numbness of fingers/toes and fatigue. No additional neuro symptoms
  - Labs: Vitamin B12: 182 (211-911)
  - Folate: 6.0 (2.5 – 10.0)
  - Treatment initiated: Now – > 1000
  - Resolution of symptoms

Case Study - 3

18 year old female presents with fatigue and sob while cheerleading. +Increase in ice consumption. PE-pallor, pale conjunctiva, systolic murmur, and tachycardia.

CBC: wbc 7.58, rbc 3.02, hbg 5.4, hct 18.7, MCV 61.9, MCHC 28.9, RDW 18.7, Normal diff. Peripheral Smear: aniso, microcytes, hypochromia, teardrop cells, few ovalocytes, elliptocytes.

What type of anemia does she have?
What would you order?

Case Study-4

26 year old male presents for a complete physical. He is asymptomatic. Routine labs reveal the following:

CBC: wbc 7.78, rbc 5.84, hbg 11.5, hct 38.5, MCV 68.2, MCHC 28.1, RDW 14.9; Normal diff.

Peripheral Smear: 1+microcytes, ovalocytes, target cells, and basophilic stippling. Remainder of labs normal.

What type of anemia does she have?
What would you order next?
Liver Function Tests

Function of the Liver
- Numerous functions
  - Production of plasma proteins
  - Glucose homeostasis
    - Production occurs significantly at night
  - Lipoprotein synthesis
    - Necessary for sex hormones
  - Bile acid production
    - LDL production
  - Vitamin B12, A, D, E, K storage

Additional Functions
- Detoxification of medications and endogenous substances
  - Primarily through the CY P450 enzyme
  - Purpose: take fat soluble medication and convert to water soluble for purposes of renal excretion
- Production of clotting factors
**Liver Function Tests: Are They Really?**
- Although we do monitor liver functioning (LFT's)...
  - It is important to remember that these enzymes are really not good indicators of functioning but more...markers of liver damage and abnormalities in bile flow....
- Normal liver enzymes can be present in the setting of liver damage
  - We see this frequently in patients with chronic hepatitis C
  - 33% of patients with chronic hepatitis C have normal LFT's

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**Most Important LFT’s:**
These Do Provide Information on Function
- Albumin
- Bilirubin
- Prothrombin Test

- All provide best information on function of the liver
- Whereas...AST, ALT – provide information re: liver injury or damage

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**Albumin**
- Albumin – serves as an index of the liver functioning/synthesis ability
- Synthesized exclusively by the liver
- Essential for the transportation of endogenous and exogenous substances
- Not completely sensitive or specific

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Albumin

- Half-life: 3 weeks
- Provides better information regarding chronic liver disease than acute liver injury/function

Low Albumin (Liver Causes)

- Cirrhosis
  - Up to 80% of patients with cirrhosis will have normal albumin
- Malignancy
- Chronic Liver Disease

Low Albumin with Normal LFT's

- Consider
  - Non-hepatic causes
    - Protein loss: Proteinuria
    - Acute or chronic inflammatory states
    - Burns
    - Sepsis
    - Trauma
    - Rheumatic disorders
    - Intravenous fluids
Bilirubin

- Results from the enzymatic breakdown of heme in the body
- Unconjugated (indirect) and conjugated (Direct) = total bilirubin
  - If total bilirubin is elevated – ask for breakdown

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Bilirubin

- Conjugated (Direct) levels do not become elevated until the liver has lost at least ½ of its excretory capacity
  - Conjugated bilirubin is rarely present in the blood in healthy individuals
  - Thus – when conjugated bilirubin is elevated – there is a marked decrease in secretion into the bile
    - Increase in bilirubin in serum and urine
    - Hepatobiliary disease is very common

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Causes of Elevated Bilirubin

- Common to see slight elevation in bilirubin after fasting
  - 12 – 24 hours
- Elevated bilirubin –
  - Elevated unconjugated (indirect) with normal CBC
    - Gilbert’s syndrome
    - Neonatal jaundice
  - Elevated conjugated (direct)
    - Hepatobiliary disease is almost always seen
    - Cholestasis/hepatocellular diseases of all types
Causes of Increased AST or ALT in Asymptomatic Patients

- A - Autoimmune Hepatitis
- B - Hepatitis B
- C - Hepatitis C
- D - Drugs or Toxins
- E - Ethanol
- F - Fatty Liver
- G - Growths (tumor)
- H - Hemodynamic disorders (CHF)
- I - Iron
- J - Copper
- M - Muscle injury

Adapted from http://www.aafp.org/afp/990415ap/2223.html accessed February 9, 2006

Narrowing It Down

¾ of all elevated AST and ALT values are caused by:
- Alcohol
- Hepatitis B
- Hepatitis C
- I would add - fatty liver (NASH)

Adapted from http://www.aafp.org/afp/990415ap/2223.html accessed February 9, 2006

AST (Formerly SGOT)

- Enzyme found within the liver cell
- Rises rapidly with hepatic injury
- Resolves very quickly
- Half life - 17 hours
- Not as specific to the liver as ALT
- Found also in heart muscle, skeletal muscle, pancreas, kidney, brain, lung, white and red blood cells
- Alcohol
- Statin medications
- Tylenol

www.fhea.com

Adapted from http://www.aafp.org/afp/990415ap/2223.html accessed February 9, 2006
ALT (Formerly SGPT)

- More specific than AST to liver
- Half life - 47 hours
- Avandia or Actos
- Liver infection or diseases
- Toxic agents

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Approach to Patient with Asymptomatic Elevation

- Person asymptomatic and picked up on screening or monitoring for various medications
  - Repeat enzymes in next 2 weeks
  - Avoid alcohol, acetaminophen, ibuprofen
  - 50% of individuals will have normal LFT’s upon repeat
  - Remember –
    - Hepatitis C patients do have fluctuating LFT’s and you may be falsely assured

Degree of Elevation

- Degree of Transaminase elevation provides significant clues as to the etiology of the liver problem
  - < 5 times – mild
  - 5 – 10 times ULN – moderate
  - > 10 times ULN – marked/severe
- For instance:
  - > 1000 units/L: hepatitis, drugs or toxins, acute biliary obstruction
  - Another way to look at this: moderate – marked increase – acute hepatic injury
Gary

- 48 year-old male who presents for routine annual examination (new patient to practice)
- Complaining of increased abdominal bloating and on further questioning – breast enlargement
- Social history: 8 – 16 beers daily; Cigarette abuse – 1 ppd x 30 years
- PMH: Asthma - childhood

Laboratory Evaluation

- CBC with differential
  - Hgb: 13.2
  - Hct: 40.0
  - MCV: 108
  - MCHC: 33
  - RDW: 16%

Liver Function Tests

- AST: 178
  - (normal 0 – 40)
- ALT: 86
  - (normal 0 – 40)
- AST/ALT > 1
  - If AST/ALT is > 1
  - Consider: AST
AST/ALT > 1

- Highly suggestive of alcoholic liver disease
- If ratio is > 2: VERY suggestive of alcoholic liver disease
  - One study showed that 90% of individuals who presented with an AST/ALT ratio > 2 had alcoholic liver disease on biopsy
  - This percentage is 96% when AST/ALT ratio is > 3
  - Gary’s Ratio: > 2 (178/86)

The Good News

- With sobriety
  - AST – normalize within 3 months
  - GGT – normalize within 1 – 2 weeks
  - Triglycerides – normalize in 1 month
  - MCV – normalize within 4 months
  - But remember…these are not liver function tests, they are liver injury tests
  - Normalization does not mean that there is NO damage

AST/ ALT < 1

- This is the most commonly encountered abnormality
  - Consider Avandia/Actos
  - Liver infection or disease (NASH)
  - Toxic agents
**NASH**

- Fatty liver is thought to be present in up to 23% of Americans
- Typical Picture: Obese, hyperlipidemia, hypertension, diabetes
  - AST/ALT ratio < 1 is most common initially
  - Ratio can shift – AST/ALT > 1
  - Indicative of advanced fibrosis – 61% of patients with advanced fibrosis will have this ratio
  - Increased GGT – up to 3x ULN

**Other Differentials: AST/ALT < 1**

**Hepatitis**

- Hepatitis A IgM
- Hepatitis B sAg
- Anti Hep C
  - Hepatitis C RNA
- Hepatitis D IgM
- Alpha1 Antitrypsin

**Other Differential AST/ALT < 1: Hemochromatosis**

- Autosomal recessive condition
- Abnormal deposition of iron in the liver, heart and pancreas
- Labs:
  - AST/ALT < 1 – often seen
  - Elevated ferritin (> 300+)
  - Transferrin saturation index
  - > 45% is highly suggestive of this condition
Earl

66 year old man employed by the town presents with a 6-day history of a cough, worsening sob, fever, chills, pain in back with inspiration, and yellow-brown sputum.
- PMH: Nonsmoker, Hx: MI age 51, Type 2 Diabetes
- PE: T: 103.8; P: 148; R: 32; BP: 138/90; HEENT: unremarkable; Tired appearing; Lethargic; Crackles in right lower lobe; Do not clear with coughing
- Finger stick: 188
- Xray: Consolidation-RLL
- Sputum Gram Stain: Pending

Let’s Talk About White Blood Cells and the Differential: What Do Each of the Components Mean?
Leukocytes or WBC's

- Heterogeneous group of cells
  - Arise from single stem cell
- Differentiation occurs during stem cell maturation

White Blood Cells

- WBC’s or leukocytes are divided into 2 groups
  - granulocytes and agranulocytes
- Granulocytes: receive their name from the granules that are present in the cytoplasm of the cell
- Agranulocytes – absence of granules

Infection/Inflammatory Response

- Inflammatory process occurs in response to exposure to an infection and/or an acute inflammatory process
  - Results in the release of inflammatory mediators
- Causes the mobilization of leukocytes
- Leukocyte released and lives for 13 – 20 days
- Destroyed by the lymphatic system
- Excreted from the body in fecal matter
Action of Leukocytes

- Leukocytes fight infection and defend body by a process called phagocytosis
  - Leukocytes encapsulate the foreign organism and destroy it
- Leukocytes: produce, transport and distribute antibodies in response to the foreign organism

Interpreting the WBC Count

- Useful guide as to severity of the infection, however, can be fooled by this as well
- Normal Leukocyte count:
  - Adult: 4,500 – 10,500/mm³
  - Children: 6 – 18 years
    - 4,800 – 10,800/mm³

But...Not Always Related to Infections

- Leukemia
- Trauma
- Bronchogenic carcinomas
- Uremia
- Drugs (quinine, epinephrine)
- Acute hemolyis
- Hemorrhage
- S/P splenectomy
- Polycythemia Vera
- Pregnancy
Earl

66 year old man employed by the town presents with a 6 day history of a cough, worsening sob, fever, chills, pain in back with inspiration, and yellow-brown sputum.

- PMH: Nonsmoker, MI-age 51; Type 2 Diabetes
- PE: Crackles in right lower lobe; Do not clear with coughing. RR - 32
- Xray: Consolidation-RLL
- Sputum Gram Stain: Pending
- CBC: wbc 16,500; Bands 7%, Neuts: 83%
- Blood cultures pending

Differential: Functions of Circulating WBC’s

- Neutrophils: bacterial infections
- Eosinophils: allergic disorders and parasitic infections
- Basophils: parasitic infections, some allergic disorders (store histamine); inflammation
- Lymphocytes: viral infections
- Monocytes: Share vacuum cleaner function with neutrophils, severe infections
- Bands/stabs: severe bacterial infections

Normals

<table>
<thead>
<tr>
<th>WBC Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrophils</td>
<td>30% - 70%</td>
</tr>
<tr>
<td>Lymphs</td>
<td>15% - 40%</td>
</tr>
<tr>
<td>Monocytes</td>
<td>2% - 8%</td>
</tr>
<tr>
<td>Eosinophils</td>
<td>0% - 5%</td>
</tr>
<tr>
<td>Bands</td>
<td>0% - 4%</td>
</tr>
<tr>
<td>Basophils</td>
<td>0% - 3%</td>
</tr>
</tbody>
</table>
Earl

- 66 year old man employed by the town presents with a 6 day history of a cough, worsening sob, fever, chills, pain in back with inspiration, and yellow-brown sputum.
  - PMH: Nonsmoker, Type 2 Diabetes
  - PE: Crackles in right lower lobe; Do not clear with coughing.
  - RR: 32
  - Xray: Consolidation-RLL
  - Sputum Gram Stain: Pending
  - Neuts: 83%
  - Blood cultures pending

Neutrophils

- Most numerous and most important leukocytes in the body
- Polys/segs often used interchangeably
- Constitute our body’s primary defense against infection through the process of phagocytosis
  - Immature neutrophils: stabs or bands

Neutrophils

- First responders to a bacterial infection
- Life span
  - 10-hours in circulation
  - 4-5 days in tissue
- Highly mobile
- Death of neutrophils in large numbers forms pus
Neutrophilia

- Causes of Neutrophilia
  - Bacterial Infection
  - Inflammatory causes
    - RA, Pancreatitis, Gout
  - Burns
  - Acute hemorrhage
  - Uremia, DKA
  - Tumor necrosis
    - Significant elevation

Bands

- Bands (0% - 4%)
  - Immature neutrophils
  - Neutrophil form with banded nucleus, and distinctive granules
  - Termed band because of the appearance of the nucleus.
    - It has not developed into the lobed shape that is present in a mature neutrophil

Earl

- 66 year old man employed by the town presents with a 6 day history of a cough, worsening sob, fever, chills, pain in back with inspiration, and yellow-brown sputum.
  - PMH: Nonsmoker, Type 2 Diabetes
  - PE: Crackles in right lower lobe; Do not clear with coughing.
    - RR - 32
  - Xray: Consolidation-RLL
  - Sputum Gram Stain: Pending
  - CBC: wbc 16,500; Bands 7%, Neuts: 83%
  - BUN - 42
    - Blood cultures pending
What Does Earl Have?

Left Shift
- Elevated wbc count
- Elevated neutrophil count
- Elevated band count

Next Day:
Repeat CBC with Differential
- Earl seems to be worsening
  - Temp still 102-103;
  - RR: 34 labored
- More lethargic; seems confused
- Moved to intensive care unit
CBC with differential
- WBC count: 12,100/mm$^3$ (↓)
- Neuts: 58% (↓)
- Bands: 20% (↑)
- Now we see the presence of:
  - Metas: 3% (↑)
  - Metamyelocytes: 2% (↑)

Cells typically found in bone marrow
- Metamyelocyte
  - Crescent-shaped nucleus
- Myelocyte
  - Round nucleus, small number of granules
- These cells are typically recruited when circulating WBC's i.e. neutrophils and bands have been exhausted

Degenerative Left Shift
- When available and more mature neutrophils forms are exhausted
  - Less mature forms accessed
    - Total number of WBC's begin to fall
    - General supply is less
The sign of….
- A desperate attempt to control infection…..
- Often associated with a very poor prognosis

Earl: CBC with differential
- WBC count: 12,100 (↓): Was 16,500
- Neuts: 58% (↓): Was 83%
- Bands: 20% (↑): Was 7%
- Metas: 3% (↑)
- Metamyelocytes: 2% (↑)

Unfortunately, Earl…
- Continued to worsen
- Grew out: DRSP and despite multiple antibiotics/ventilator assistance etc, he did not survive the pneumonia and died within 48 hours of presentation
Had Earl Recovered…This is What We Would Have Seen!

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Sean

- 14 month-old w/ 5-day hx fever, irritability, no wet diaper in >6 h
  - H/ H= 11g / 37%
  - WBC= 2,600 mm³
  - Neuts= 35%
  - Bands= 48%
  - Metas= 2%

Degenerative Shift

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Sean

- After initiation of antimicrobial therapy and rehydration
  - WBC= 7,200 mm³
  - Neuts= 59%
  - Bands= 10%
  - Monos= 10% (>5%)
Regenerative Left Shift

- Rise in total WBC
- Drop in immature forms
- Rise in monocytes
  - Predictor of recovery

MA

- 19 year-old male who presents with a sore throat, low-grade fever, achiness, fatigue x 5 days
- Decreased appetite
- No other family members ill
- Has missed 3 days of school
- Denies medications

Physical examination

- VSS: T:99.2; RR – 18; Pulse - 104
- Skin: p/w/d; no jaundice
- Ears: Canals/TM’s normal
- Nose: Turb/mucosa pink; no discharge
- Mouth: Tonsils erythem; +exudate; no petecchiae
Physical examination

- Nodes: .5 cm tonsillar, occipital, posterior cervical nodes
- Lungs: clear bilaterally; no c/w/r
- Heart: S1S2: RRR; no murmurs
- Abdomen: +BS; +hsm; R&L UQ tenderness; no masses, rebound, guarding
- Eyes: no icterus

Michael

- WBC = 3,900 (4,500-10,500/mm³)
- Neuts = 25% (40% - 70%)
- Bands = 3% (0 - 4%)
- Lymphs = 64% (20% - 42%)

Labs

- Mono: +
- CMP:
  - AST: 48 (0-40)
  - ALT: 89 (0-40)
  - Otherwise normal

Diagnosis: Mononucleosis
Leukopenia

- Leukopenia: WBC < 4500
  - Viral infections, some bacterial infections, (overwhelming bacterial infections)
  - Primary bone marrow disorders
    - Leukemia, aplastic anemia, pernicious anemia
  - Pernicious anemia
  - Mononucleosis
  - Medications (antibiotics, anticonvulsants, chemotherapy, diuretics)

Lymphocyte

- 2nd most numerous WBC in circulation
- 15% - 40% of total WBC count

Other Differentials: Lymphocytosis

- Lymphatic leukemia
  - Acute and chronic
- Inflammatory bowel disease
  - Crohn’s and Colitis
- Addison’s disease
- Thyrotoxicosis
Monday, September 25

17 year old male presents with a 3 week history of fatigue, nasal discharge-clear; seen by MD 1 week prior and started on Augmentin. Not feeling any better. PE: pallor, tachycardia, diaphoretic; Lungs clear, HEENT-normal; CBC: wbc: 8.9; rbc: 1.54; hgb: 5.5, hct: 17.2, MCV: 112, MCHC: 32; platelet: 32; Bands: 0; Segs: 5 (L) Monocytes: 21, Abnormal lymphocytes: 33.

Thank You!!

I Would Be Happy to Answer Any Questions You May Have

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