Multiple Myeloma by the Numbers

A Review of Common Labs and What They Mean

Before we begin...

Critical lessons before reading labs:

- Look at the units: Different labs use different units of measurement. For example SCCA measures free light chains in mg/dL, Good Samaritan Hospital measures in mg/L so a kappa free light chain at SCCA will be 0.89 while at Good Sam it will be 8.9.

- Look for the trend: Think about the reason. For example: A hemoglobin in a patient is 9.8, the week before it was 10.2. So it dropped, but in looking at the two weeks before that it was 9.9 and 10.4. The trend is stable.

- Do not fixate on *normal*: A person with multiple myeloma, who is receiving treatment is not going to exhibit all normal results. Look for stability or improvement.

Why do we draw labs with MM?

- Diagnosis

- Assess status of disease.

- Determine response to treatment.

- Identify abnormalities caused by disease and/or treatment.
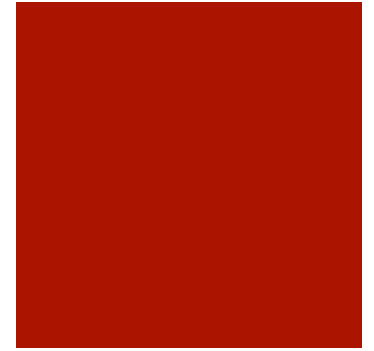
Multiple Myeloma Associated Labs

- Basic metabolic panel (BMP)

- Hepatic panel (LFT)

- Comprehensive metabolic panel (CMP)
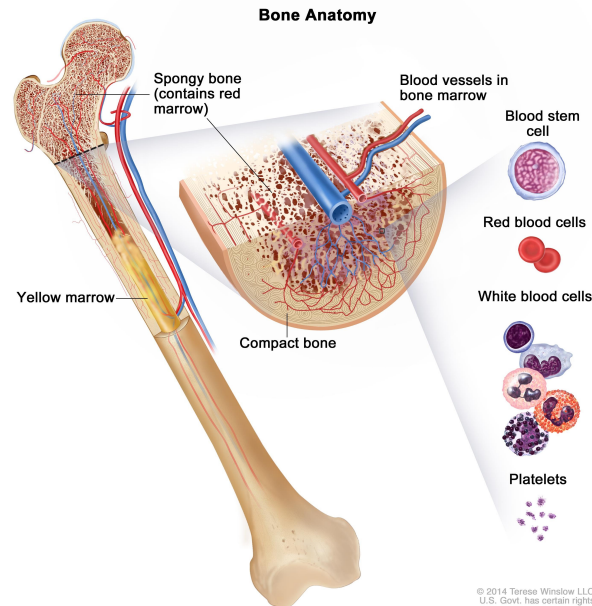
- Complete blood count (CBC)

MM Associated Labs

- Basic metabolic panel (BMP)
  - Measures kidney function (creatinine), electrolytes (sodium (Na), potassium (K), calcium (Ca)), glucose, bicarbonate and chloride.

- Hepatic panel (liver panel, liver function test, LFT)
  - Measures the function of the liver, an organ critical in medication metabolism and filtering toxins.
    - Enzymes: ALT (alanine aminotransferase), AST (aspartate aminotransferase), ALP (alkaline phosphatase).
    - Proteins: Albumin, bilirubin, total protein.

- Comprehensive metabolic panel (CMP)
  - A combination of BMP and hepatic panel.

MM Associated Labs

- Complete blood count (CBC):
  - A test that quantifies the levels of blood cells in <u>circulation</u>. It does not count what is in bone marrow (but it can give clues).

Bone Anatomy

Spongy bone (contains red marrow)

Blood vessels in bone marrow

Blood stem cell

Red blood cells

White blood cells

Yellow marrow

Compact bone

Platelets

© 2014 Terese Winslow LLC
U.S. Govt. has certain rights

MM Associated Labs

Circulating blood is made up of red blood cells (RBC), platelets (PLT) and white blood cells (WBC) suspended in a fluid plasma (*not to be confused with plasma cells in marrow*).

- A complete blood count (CBC) measures the levels of red blood cells (including hemoglobin and hematocrit), white blood cells (WBC), platelets (PLT) and other components of circulating blood.

- The differential counts the five different types of white blood cells (neutrophils, lymphocytes, eosinophils, basophils, monocytes).

  - With multiple myeloma we monitor the absolute neutrophil count (ANC) closely because they are they make up the largest number of WBCs and are utilized against bacteria.

Multiple Myeloma Specific Labs

- Serum free light chains (SFLC)

- Immunoglobulins

- Serum protein electrophoresis (SPEP)

- Urine protein electrophoresis (UPEP)

Labs Specific to MM

Please remember the labs we use to monitor abnormal proteins in the blood (SPEP and SFLC) are a reflection of what is <u>likely</u> occurring in the marrow. Thus we can use these labs to determine status of disease (much easier than getting monthly marrows).

Serum Free Light Chains

- An important lab in <u>diagnosing</u>, assessing response and monitoring MM.
  - Kappa and lambda light chains are proteins produced by plasma cells in marrow.
  - They bind with heavy chains and form immunoglobulins (antibodies) and play a critical role in defending the body from bacterial and viral infections.
  - Plasma cells normally produce an small excess of light chains that do not bind with heavy chains. These unattached light chains are called *free* light chains.

Serum Free Light Chains

- With multiple myeloma the plasma cell becomes neoplastic (mutates) and produces abnormal levels of **one** type of free light chains (either Kappa or Lambda, but not both).

- With multiple myeloma the affected/dominant free light chain *increases* above normal range and the unaffected free light *declines* below normal range.

- The goal with treatment is to normalize free light chain numbers and have a ratio that is near 1.

- Free light chain numbers and ratios are used in the diagnosis of MM and response to treatment.

Serum Free Light Chains

- Ratio

- Ratio

- Ratio

Immunoglobulins
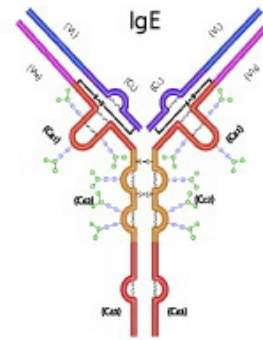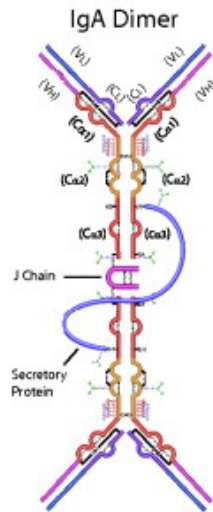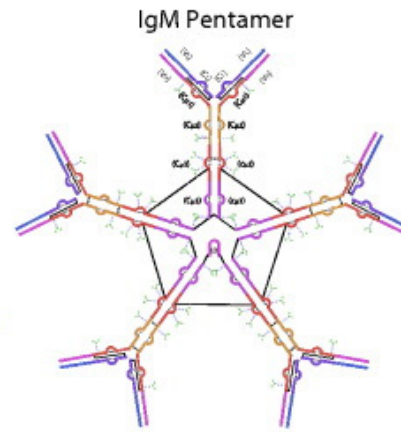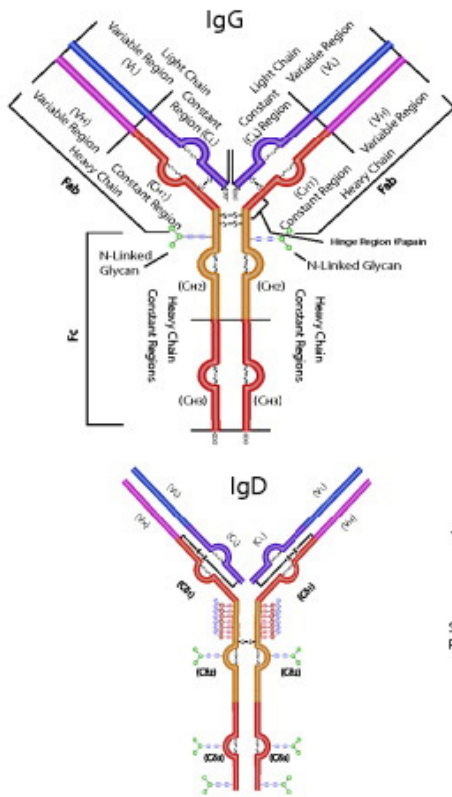
Immunoglobulins

- Proteins are generated by plasma cells in marrow to suppress antigens.
  - 5 types M, A, D, G, E. We all produce them in varying numbers. These are the heavy chain part of an immunoglobulin.

- With multiple myeloma there is an increased number of a single type of immunoglobulin, usually immunoglobulin G (IgG), because of the proliferation of abnormal plasma cells in the marrow that produces them.

- Not used as a tool for diagnosis or response.

Serum Protein Electrophoresis
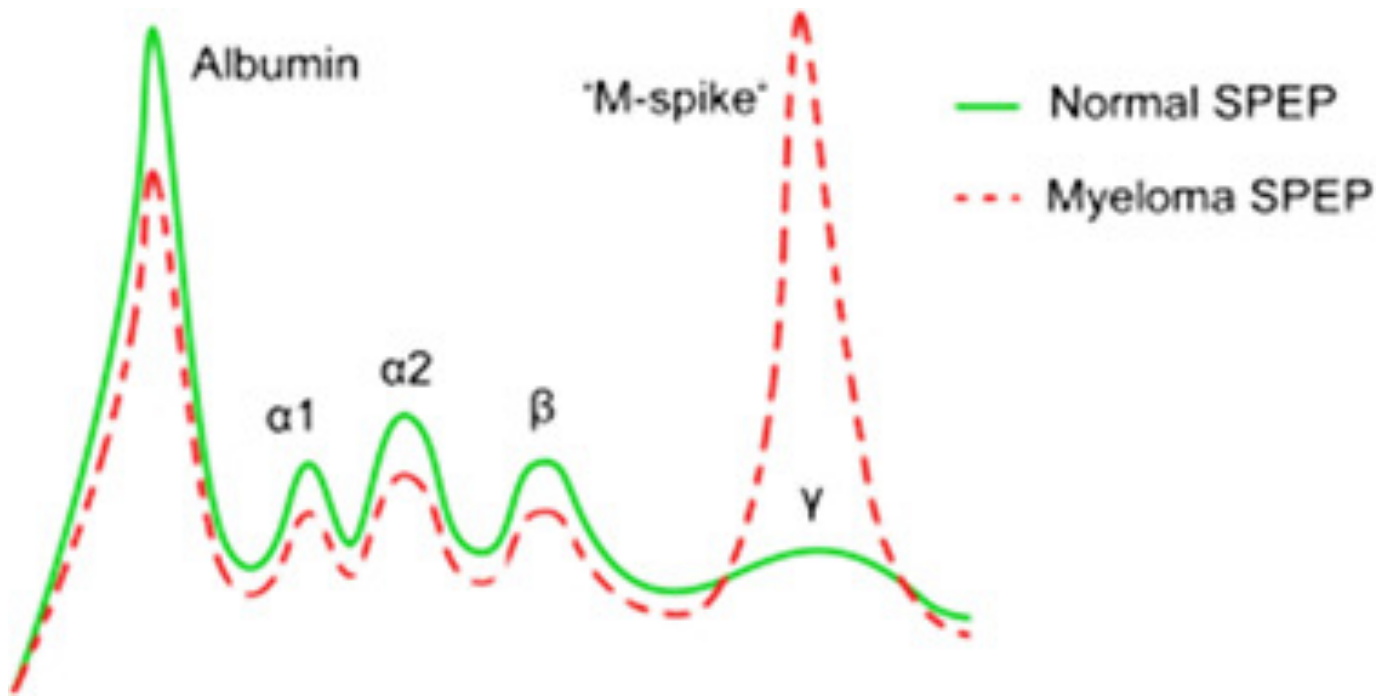
Serum Protein Electrophoresis
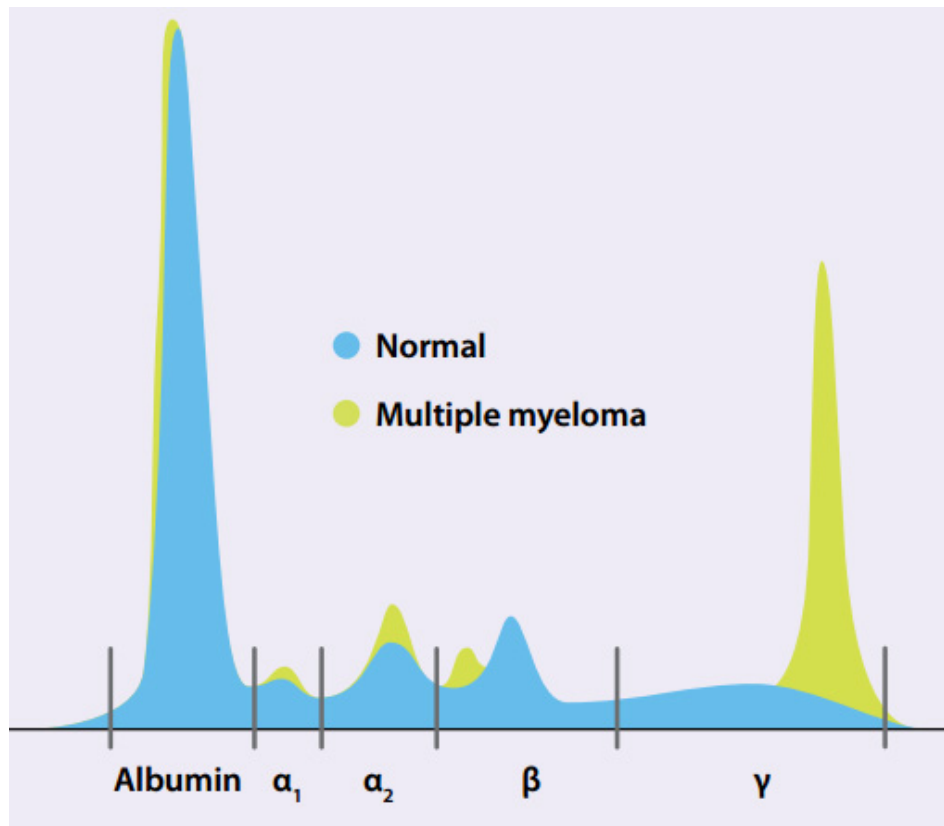
Serum Protein Electrophoresis

One of the primary issues with interpreting this lab is finding it. It is under many names depending on the lab:

- Monoclonal protein quantitative (SCCA)
- Immunofixation electrophoresis
- Immunosubtraction electrophoresis
- Abnormal protein
- Monoclonal immunoglobulin
- And many more…

Commonly referred to as "M-spike"

Serum Protein Electrophoresis

- With multiple myeloma the plasma cell becomes neoplastic (mutates) and produces abnormal levels of ***one*** type of whole immunoglobulin (typically a combination of free light chains and usually either an IgG, IgA or IgM immuoglobulin). The number of abnormal immunoglobulins in circulation is the M-spike.

- The goal with treatment is to reduce the M-spike to non-detectable (unlike the free light chains which is to return to normal limits).

- The M-spike is the ideal marker for response to treatment as the level is only affected by the presence of disease. *However, it is not officially used as a diagnosis of the disease.*

Urine Protein Electrophoresis
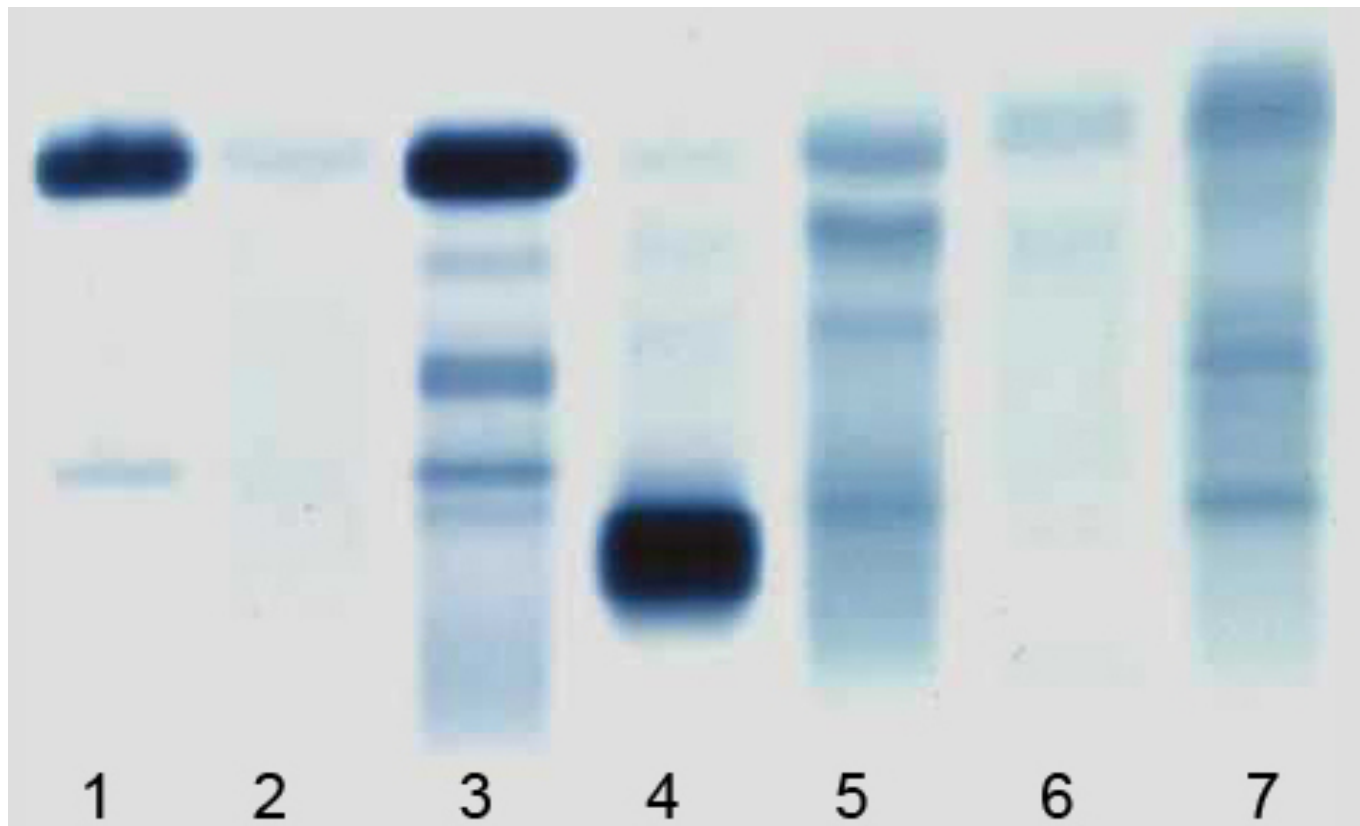
Urine Protein Electrophoresis

- Advised by NCCN and IMWG as part of the work up in diagnosing. Can be used for assessing response and monitoring MM.
  - About 10-15% of patients do not exhibit a characteristic peak in protein via serum.
  - Typically those who do not secrete in serum do exhibit protein in urine (widely referred to as Bence Jones proteins).
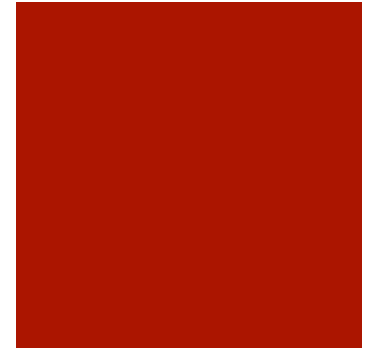 - Not part of the diagnosis of multiple myeloma by CRAB criteria or myeloma defining events (MDE).
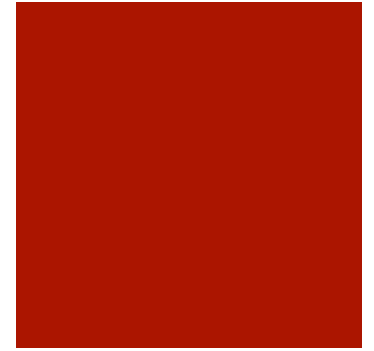
Case 1 - FLC

Kappa free light chain: 110mg/dL (range 0.33 – 1.94mg/dL)

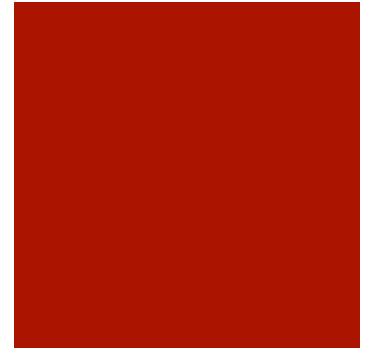Lambda free light chain: 0.25mg/dL (range 0.57 – 2.63mg/dL)

Which is the affected free light chain?

Case 1- FLC

Kappa free light chain: 110mg/dL (range 0.33 – 1.94mg/dL)

Lambda free light chain: 0.25mg/dL (range 0.57 – 2.63mg/dL)

Case 2 - Immunoglobulins

IgG: 2359mg/dL (range 610- 1616mg/dL)

IgM: 45mg/dL (range 40 – 350mg/dL)

IgA: 210mg/dL (range 84-499mg/dL)
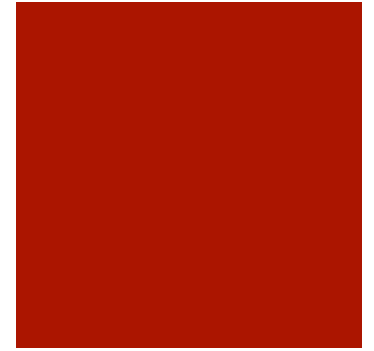
Which is abnormal immunoglobulin?

Case 2 - Immunoglobulins

IgG: 2359mg/dL (range 610- 1616mg/dL)

IgM: 45mg/dL (range 40 – 350mg/dL)

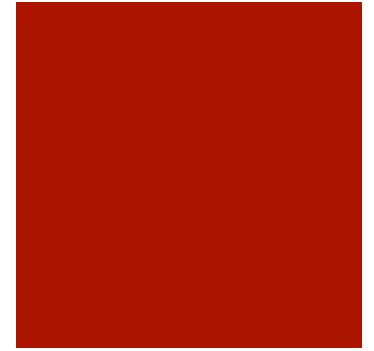IgA: 210mg/dL (range 84-499mg/dL)

Case 1 + 2 – Type of MM

IgG: 2359mg/dL (range 610- 1616mg/dL)

IgM: 45mg/dL (range 40 – 350mg/dL)

IgA: 210mg/dL (range 84-499mg/dL)

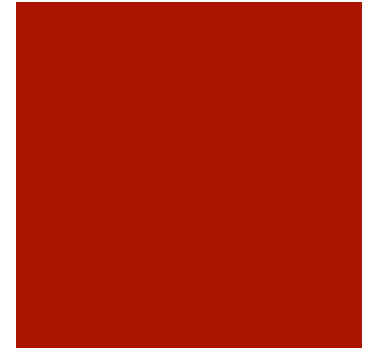**Kappa free light chain**: 110mg/dL (range 0.33 – 1.94mg/dL)

Lambda free light chain: 0.25mg/dL (range 0.57 – 2.63mg/dL)

Case 1 + 2 Type of MM

What type of multiple myeloma does this patient have?

A) IgM Lambda

B) IgG Kappa

C) IgA Kappa

D) All of the above
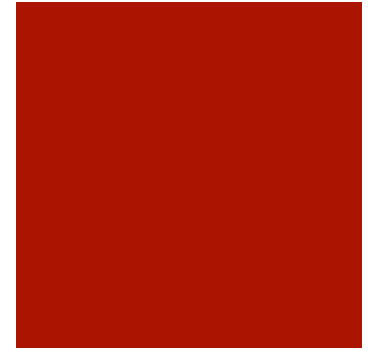
Case 1 + 2 Type of MM

What type of multiple myeloma does this patient have?

A) IgM Lambda

B) IgG Kappa

C) IgA Kappa

D) All of the above

Questions?