What is Myeloma?

Multiple myeloma develops when plasma cells grow out of control with the capacity to spread and sometimes become resistant to treatments. Plasma cells, a type of blood cell, are found in bone marrow (the soft inside part of bones) and are part of the immune system. These cells start out as lymphocytes, including B cells that mature into antibody-producing plasma cells when they fight an infection. When these cells grow out of control, they produce an abnormal protein known as monoclonal protein or M protein. The same protein is also known as monoclonal immunoglobulin, M spike or paraprotein. This is the hallmark of myeloma. M proteins can circulate in the blood and lead to organ damage, including kidney failure and nerve damage. Myeloma often does not cause symptoms until it reaches advanced stages. This can cause bone pain, weakness, or fractures in bones including with or without trauma. Some present with confusion, dizziness, shortness of breath, leg swelling due to kidney failure or infections such as pneumonia.

Common Myeloma Labs and Tests

Helpful hints:

- Always look at trends over time. One test is just a snapshot. Understand what the last several tests show regarding whether the numbers are up, down or stable. Each lab in My Chart will have a view you can open called “view trends” in the right-hand corner. Click on that link and you can see a graph of that test. Each lab test should have this view.
- Pay attention to the units. These can differ between locations.
- Normal ranges of tests or components can be found in MyChart
- Everyone’s “normal” is different. With Myeloma, your labs are not often “normal” but will be stable for you. Again, looking at trends for you over time.

COMPLETE BLOOD COUNT (CBC)

Looks at blood in circulation (not in the bone marrow)

Red Blood Cells (RBC)

- **RBC**: Red blood cells (erythrocytes) are derived from stem cells in bone marrow. They transport oxygen (O2) from the lungs to the periphery, and Carbon Dioxide (CO2) back from the periphery to the lungs. The average life span of an RBC is 110 days.
- **Hemoglobin** – iron containing protein in red blood cells that carries oxygen to your tissues. Measured as the amount of hemoglobin in a volume of blood and is an indirect measurement of the RBC count.

- **Hematocrit** – percentage by volume of the red blood cells in your blood. (An indirect measurement of RBC count. Hematocrit like hemoglobin was readily available before the availability of automated blood cell counting machines.)
MCV (Mean Corpuscular Value) – Average size (volume) of the red blood cells. Will vary based upon nutritional deficiencies and stresses on the RBC development and survival.
MCH (Mean Corpuscular Hemoglobin)- The average amount (weight) of hemoglobin measured in each RBC. (Low MCH may indicate lack of iron while high MCH may indicate lack of B12 or folic acid)
MCHC (Mean Corpuscular Hemoglobin Concentration)- Similar to MCH but adjusted to the size of the RBC.
(the MCV, MCH, and MCHC are complementary to one another and together help one determine the likely cause of anemia (low RBC, hemoglobin and hematocrit).

White Blood Cells (WBC) – are a heterogeneous (cells in different phases) group of cells that can be found in circulation for a period of their life. The normal concentration in blood varies between 4,000 and 10,000 per microliter. They play an important role in phagocytosis (surrounding and killing microorganisms, ingest foreign materials and removes dead cells) and immunity and therefore in defense against infection.

5 major components exist at different levels in your blood. (Total WBC count includes the 5 different components or subtypes of white blood cells and is measured by an automated blood cell counting machine. The WBC is reported as the number of WBCs per volume of blood. Each WBC subtype is reported as an absolute count and the percentage of the total WBC count.

- **Neutrophils** – help fight infections. These are the most numerous white blood cells.
- **Lymphocytes** – part of the immune system. Two main types – B cells and T cells.
- **Eosinophils** – Destroy matter identified by your immune system as harmful. (involved in numerous inflammatory processes including anti-bacterial, antiparasitic, and allergic reactions)
- **Basophils** – works with immune system to defend you from allergens, pathogens and parasites
- **Monocytes** – Destroy germs (viruses, bacteria, fungi and protozoa). Eliminate infected cells.

Platelets – small blood cells which work with clotting proteins to help form blood clots and stop bleeding.

BASIC METABOLIC PANEL (BMP)

(Glucose, Calcium, Sodium, Potassium, Bicarbonate (CO2), Chloride, BUN, Creatinine)

HEPATIC PANEL

(LFT – Liver Function Test) (bilirubin, AST (SGOT), ALT (SGPT), alkaline phosphatase)

Electrolytes – minerals that carry an electrical charge in liquids. These 4 minerals are basic to all cellular functions and maintain acid-base balance in your blood,

- Sodium – important for nerve and muscle function
- Potassium – important for muscle contraction, heart rhythm and fluid balance
- Chloride - to diagnose or monitor conditions, such as kidney disease, heart failure, liver disease, and high blood pressure
- Carbon Dioxide (bicarbonate) – shows if you are retaining or losing acidic fluid

- **Anion Gap** – measures the electrolyte imbalance or acid-base balance in your blood.
- **Bilirubin** – produced during the breakdown of red blood cells. Generally elevated when RBC breakdown is rapid and/or the liver is sick and cannot metabolize bilirubin from the normal turnover of RBCs.
- **Urea Nitrogen (BUN**) – A byproduct of normal cell turnover and protein breakdown. Higher levels can suggest decreased kidney function or dehydration.
- **Creatinine** –Creatinine is a waste product of muscle metabolism which is cleared by the kidneys. It is primarily elevated in kidney disease, (and is mildly elevated in individuals with a greater muscle mass). Creatinine clearance is a more precise measurement of kidney function based upon the creatinine in both the blood and urine.
- **eGFR (Estimated Glomerular Filtration Rate)** – measures how well your kidneys are filtering certain agents in your blood, such as creatinine.
- **Protein** – large, complicated molecules that are vital to the function of all cells and tissues. They are made in many places throughout your body and circulate in the flood. Proteins take a variety of forms, such as albumin, antibodies and enzymes and have many different functions including Helping you fight disease, regulating body functions, building muscles and transporting drugs and other substances throughout the body. Elevated Protein can indicate dehydration, inflammation, Hepatitis C, Amyloidosis, HIV, Multiple Myeloma.
- **Albumin** – the most abundant protein in blood and is essential in maintaining fluid balance on a cellular level and between the blood vessels and tissues. Lower levels seen in liver or kidney disease, malnutrition or inflammation and can indicate thyroid disease, infection, malnutrition, weight loss surgery. High levels (hyperalbuminemia) can be caused by dehydration and certain medications or a high protein diet.

Calcium- important for heart function, and helps with muscle contraction, nerve signaling, and blood clotting. If there is too much or too little, may signal bone disease, thyroid disease, parathyroid disorders, kidney disease.

Phosphate - essential for the production of energy, muscle and nerve function, and bone growth

- **AST** – a liver enzyme that breaks down amino acids. Increased levels are related to liver inflammation or injury.
- **ALT** – enzyme that converts protein into energy. When the liver is damaged or inflamed the ALT levels in the blood increase.

- **Alkaline Phosphate** – an enzyme that breaks down proteins. ALP is an enzyme found in many parts of your body. Each part of your body produces a different type of ALP. Most ALP is found in your liver, bones, kidneys, and digestive system. Abnormal levels of ALP in your blood may be a sign of a wide range of health conditions, including liver disease, bone disorders, and chronic kidney disease. Higher-than-normal levels can indicate liver or bone damage.

COMPREHENSIVE METABOLIC PANEL (CMP)
combines BMP and Hepatic Panel

SPEP and SFLC

The following two tests provide an **ESTIMATE** of what is happening in the bone marrow and are therefore a good way to determine the status of your disease.

SERUM FREE LIGHT CHAINS (SFLC)
- Two types of light chains – Kappa and Lambda. These bind with heavy chains to form antibodies (or immunoglobulins), which help defend the body from infections.
- There are 5 types of heavy chains – M, A, D, G, E.
- Usually plasma cells produce a small excess of light chains that do not combine with heavy chains, and these are called free light chains.
- Under Myeloma, plasma cells produce abnormal levels of one type of light chain, which then exceeds normal levels, while the other type is produced at less than normal levels.
- SFLC measures the amount and type of free light chains in the blood.
- This test helps diagnose MM and gauges the response to treatment. The goal of therapy is to bring the ratio of the free light chains back to around 1.

SERUM PROTEIN ELECTROPHORESIS (SPEP) and **SERUM IMMUNOFIXATION (IFE)**
- In Multiple Myeloma, there is usually an overproduction of one type of immunoglobulin, usually G (IgG), but IgA and IgM (and rarely IgD) also occur.
- The SPEP measures the amount of M spike (the amount of the abnormal immunoglobulin) in the blood, so it is a great way to assess response to treatment. - The goal of treatment is to reduce the M spike to undetectable levels.
- The Serum immunofixation (IFE) characterizes the form of monoclonal protein (i.e. IgG kappa monoclonal protein vs IgG lambda or others)

Urine protein electrophoresis and urine immunofixation and Bence Jones proteins: Studies on the urine similar to SPEP and IFE looking for myeloma proteins in the urine.

IMAGING

X-Ray- use of gamma radiation to look at internal structures based upon varying densities. Plain X-Ray is most sensitive to bone changes such as fractures and erosions including the "lytic lesions" commonly seen in myeloma.
-**Skeletal Survey** involves taking multiple plain X-Rays to look at the entire skeleton.

CT (computerized tomography) scanning uses X-rays (and often intravenous contrast) with the addition of a scanner that simultaneously can measure multiple planes and with computer software create images with much greater detail of bone and soft tissues.
-Low Dose Skeletal CT is used to screen for bone lesions characteristic of myeloma. Far more sensitive compared to skeletal surveys.

CT-PET (positron emission tomography). These scans use standard CT scanning without IV contrast, but with the addition of a detectable radioactive agent which determines the metabolism of various organs and masses. FDG-PET is the most common form of PET scanning used for detecting and following cancer including multiple myeloma. When a bone lesion or mass is seen on the CT images, the overlying PET images will tell if these lesions are metabolically active, consistent with active cancer, or not metabolically active, consistent with successfully treated cancer.
-CT PET is used to screen and monitor for bone and other organ involvement with multiple myeloma. Like Low Dose Skeletal CT, it is much more sensitive than traditional skeletal survey for detecting myeloma-related bone lesions.

MRI (magnetic resonance imaging): Does not use radiation, but rather a magnetic field and radio waves, MRI can image the body with greater sensitivity to plain X-Ray and CT for many soft tissue and brain and spinal cord abnormalities.
-Skeletal MRI, like low dose skeletal CT and CT-PET may be used to screen for myeloma-related bone lesions.