UNDERSTANDING THE IMMUNE SYSTEM AND LABORATORY VALUES IN MULTIPLE MYELOMA

Ann McNeill, RN, MSN, APN
THE IMMUNE SYSTEM

Cellular Immune System

- White Blood Cells: Granulocytes
  Lymphocytes: T cells

Humoral Immune System

- B cells and antibodies
B Cells
work chiefly by secreting soluble substances known as antibodies (Ab) or immunoglobulins
Ab basic structure

- **Light chain**
- **Heavy chain**
- **Domains**
- **Disulfide bonds**
Types of Antibodies

- **Types of Heavy Chains**
  - IgG
  - IgA
  - IgM
  - IgD
  - IgE

- **Types of Light Chains**
  - Kappa
  - Lambda
What happens in Multiple Myeloma?

- Malignant plasma cell makes a clone of itself and these malignant plasma cells, or myeloma cells, accumulate in the bone marrow.

- The malignant plasma cells secrete an antibody, or immunoglobulin, called the M-protein, or M-spike, or paraprotein or myeloma protein. This antibody is not useful to the body. It can be detected in the blood and/or the urine of most myeloma patients.
Laboratory Testing for Multiple Myeloma

Why perform lab tests?

Goals:
- Diagnosis
- Determine severity and spread (staging)
- Monitor progress of disease
- Detect complications
- Monitor the effectiveness of treatment
Comprehensive Metabolic Panel (ChemScreen)

A group of tests used to evaluate kidney and liver function, electrolyte status, and to determine calcium and total protein levels

- Total protein
- Calcium
- Creatinine
Other chemistry tests important in Multiple Myeloma

- \( \text{Beta}_2 \)-microglobulin
- Serum albumin level
- Serum Viscosity
Complete Blood Count (CBC)

- Hemoglobin / Hematocrit
  - determines extent of anemia, if present
- White Blood Cell Counts
  - absolute neutrophil counts (ANC)
  - evaluates infection risk
- Platelet Counts
  - platelets are responsible for blood clotting
  - important in patients receiving anticoagulants
Quantitative Immunoglobulins

- Measures amounts of the different immunoglobulins
- Myeloma protein will be an $\text{IgG}$ or $\text{IgA}$, or rarely, $\text{IgD}$ or $\text{IgE}$
- Levels will help monitor the course of the disease
- Important to be aware of the levels of the normal (non-myeloma) immunoglobulins
Protein Electrophoresis and Immunofixation

- Protein electrophoresis separates the proteins in a blood or urine sample into several groups based on their size and electrical charge.

- In most patients with MM, large amounts of an abnormal immunoglobulin protein (M-spike) will appear as a large peak on the graph.

- Immunofixation is done to identify the specific type of protein that is being produced by the malignant plasma cells. The amount of protein produced may vary throughout the course of the disease, but the type will remain the same.
Normal Serum Protein Electrophoresis Pattern

Figure 1
Typical normal pattern for serum protein electrophoresis.
Abnormal Serum Protein Electrophoresis Pattern

Figure 2
Abnormal serum protein electrophoresis pattern in a patient with multiple myeloma. Note the large spike in the gamma region.
Serum Free Light Chains (FLC) or FreeLite Assay

- Measures the amount of free light chains in the serum (blood).

- In normal circumstances, plasma cells produce an excess of light chains compared to heavy chains. A small amount of these light chains will not become incorporated into intact immunoglobulins. These are “free” light chains and are released into the blood.
Most patients with Multiple Myeloma produce increased amounts of either kappa or lambda free light chains, which can be measured in the blood.

Consequently, the ratio of kappa to lambda light chains is abnormal in most patients and is a sensitive indicator for this disease.

This test may be used to monitor progression and/or treatment.
Bone Marrow Aspirate and Biopsy

- Most laboratory tests for Multiple Myeloma provide *indirect* information about the amount of tumor present, by measuring proteins that are secreted by the tumor into the blood and/or the urine.

- These tests do not provide the same information as looking at the tumor itself. The myeloma cells are usually only found inside the bone marrow.
Small fragments of bone marrow cells can be withdrawn with an aspirate needle, and a small core of bone and marrow is often removed at the same time with a different type of needle.

Both tests are done to determine how much of the normal bone marrow is replaced by myeloma cells.

Additional, specialized testing (cytogenetics and FISH) can be performed which can provide information about the biology of the tumor itself.