MULTIPLE MYELOMA (MM)

objective: definition of MM and biochemical investigation in diagnosis of this disease

Basil O M Saleh
MULTIPLE MYELOMA (MM)

- A neoplastic (malignant) proliferation of a single clone of plasma cells in bone marrow
- Major laboratory diagnostic criteria
  - >10% plasma cells in bone marrow
  - Complete or incomplete monoclonal immunoglobulin(s) in serum and/or urine at elevated concentrations
- Monoclonal Immunoglobulins (Antibodies)
  - Monoclonal proteins, M proteins or paraproteins
  - Non-functional
PARAPROTEINS ("M-proteins")

Greatly increased amounts of some normally-undetected serum protein is called paraproteinemia, and the abnormally-increased protein is called a paraprotein or M-protein. ("M" means both monoclonal and myeloma, the usual cause of an M-protein.) Most often, the paraprotein is all or part of an immunoglobulin molecule. Especially if the paraprotein is light chains, it may spill into the urine ("Bence-Jones proteinuria"). You can test urine for Bence-Jones protein by yourself, using a test tube and a Bunsen burner. Bence-Jones protein precipitates on heating (around 40-60), then redissolves just before the urine boils.
Paraprotein appears as a sharp peak (a "spike"), most often in the gamma region, though it may be anywhere.

Such a peak indicates the presence of a **monoclonal gammopathy**.

A majority of detected monoclonal gammopathies are the result of plasma cell myeloma. These patients typically have depression of other gamma globulins and albumin. Some other causes of monoclonal gammopathies include:

- Waldenstrom's macroglobulinemia
- heavy chain disease
- CLL, lymphoma, amyloidosis (occasional cases)
Normal Serum Protein
Electrophoresis
### Serum protein electrophoresis

**Date Scanned:** 2/17/2008  
**Sample number:** 5  
**Sample date:** 2/16/2008

**Patient Name:**  
**Accession number:**  
**Date of Birth:**  
**Age:** 74  
**Physician:** AMERICO  
**Medical Record #:**

- **A/G:** 0.43  
- **T. P.:** 10.7 g/dl

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<th>g/dl</th>
<th>Reference Range(g/dl)</th>
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<tr>
<td>Albumin</td>
<td>30.1</td>
<td>3.22</td>
<td>3.20 - 5.00</td>
</tr>
<tr>
<td>Alpha 1</td>
<td>2.1</td>
<td>0.22</td>
<td>0.10 - 0.40</td>
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<tr>
<td>Alpha 2</td>
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<tr>
<td>Beta</td>
<td>5.3</td>
<td>0.57</td>
<td>lo 0.60 - 1.30</td>
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<tr>
<td>Gamma</td>
<td>54.8</td>
<td>5.86</td>
<td>hi 0.70 - 1.50</td>
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<tr>
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<td>52.6</td>
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**Interpretation:**  
A MONOCLONAL PROTEIN WITH A CONCENTRATION OF 5.63 G/DL IS DETECTED IN THE GAMMA REGION. IDENTIFICATION OF THIS MONOCLONAL PROTEIN WILL FOLLOW BY IMMUNOFIXATION ELECTROPHORESIS. THERE IS A SEVERE DEFICIENCY IN THE CONCENTRATION OF POLYCLONAL ANTIBODIES.
**Urine protein electrophoresis**

Date Scanned: 2/17/2008  
Sample number: 7  
Sample date: 2/16/2008  
Patient Name:  
Accession number#:  
Date of Birth:  
Age: 74  
Physician: AMERICO  
Medical Record #:  
Urine concentration: 5  
A/G: 0.05  
T. P.: 271 mg/dL  

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<td>Beta</td>
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Comments:  
A MONOCLONAL PROTEIN WITH A CONCENTRATION OF 227.9 MG/DL AND REPRESENTING APPROXIMATELY 84% OF TOTAL URINARY PROTEIN IS DETECTED IN THE GAMMA REGION. IDENTIFICATION OF THIS MONOCLONAL PROTEIN WILL FOLLOW BY IMMUNOFIXATION ELECTROPHORESIS.
Figure 1  Immunoglobulin-free light chain assay. (a) Shows the location of the hidden light chain determinants in the intact immunoglobulin model. (b) Shows the location of the hidden light chain determinants in the free light chain model.
RADIOLOGY DIAGNOSIS OF MULTIPLE MYELOMA

- Skeletal bone X-ray series
  - Skull, spine, ribs, arms, legs and pelvis

- Alternative procedures
  - Magnetic resonance imaging (MRI)
  - Computed tomography (CT)
    - Computerized axial tomography (CAT)

- Lytic bone lesions and/or pathologic fractures
Laboratory analysis
1. significant increased ESR (erythrocte sedimentation rate) > 90 mm3/hr.
2. Serum protein electrophoresis SPE (M band)
3. Bence Jones protein BJP in urine (positive band)
4. hypercalcemia & hyperphosphatemia
5. hyperuremia & hypercreatininemia
6. hyperuricemia
7. decreased Hb
8. Hypoalbuminemia
8. Noarmal ALP
These investigation results depend on stage of MM, for example; increased urea, creatinine, uric acid and decreased s. albumin occur when kidney integrity and function decline because of precipitation of BJP in it.