📊 HEMATOLOGY AND ONCOLOGY FOR USMLE 🧪

Plasma Cell Dyscrasias

Plasma cell dyscrasias are a group of disorders caused by clonal proliferation of plasma cells, leading to monoclonal immunoglobulin (paraprotein) overproduction. Most patients are older adults.

📌 Classic feature: M spike on serum protein electrophoresis → indicates monoclonal Ig.

🔬 Pathophysiology Overview

Normal plasma cells → produce polyclonal antibodies
Clonal plasma cell proliferation → produces monoclonal Ig → Accumulation in blood/urine → End-organ damage (CRAB features in multiple myeloma)

Screening & Diagnosis:

- Serum protein electrophoresis → detects M spike (monoclonal Ig)
- Serum immunofixation → identifies Ig type
- Serum free light chain assay → detects kappa/lambda imbalance
- Urine protein electrophoresis → detects Bence Jones protein (light chains)
- Bone marrow biopsy → confirms >10% monoclonal plasma cells

🧠 Key Lab Feature

Peripheral blood smear:

- Rouleaux formation → RBCs stacked like poker chips 🃏
- Due to increased serum protein decreasing RBC zeta potential

Serum protein electrophoresis: M spike appears in the γ region typically (but can vary)

Albumin	$\alpha 1$	$\alpha 2$	β	γ M spike ✅

🩺 Disorders

1️⃣ Multiple Myeloma (MM)

🧬 Immunoglobulin

- IgG > IgA > Ig light chains

🧠 Pathophysiology

Malignant plasma cells → Secrete cytokines (IL-1, TNF-α, RANK-L) → ↑ Osteoclast activity → Bone lytic lesions ("punched-out")

Other effects:

- Hypercalcemia ⚡ → nausea, constipation, confusion
- Renal failure 💧 → light chain deposition

- Anemia → marrow replacement by plasma cells
- Immunodeficiency → infections

Mnemonic: CRAB

- C → Calcium ↑
- R → Renal failure
- A → Anemia
- B → Bone lesions

🩻 Imaging

- X-ray: "punched-out" lytic lesions, especially vertebrae → back pain

🧪 Urine Findings

- Bence Jones proteins → Ig light chains
- Urine dipstick may be negative (only detects albumin)

🧬 Bone Marrow Biopsy

- 10% monoclonal plasma cells
- Clock-face chromatin
- Intracytoplasmic inclusions (Ig accumulation)

2️⃣ Waldenström Macroglobulinemia

🧬 Immunoglobulin

- IgM → largest Ig → causes hyperviscosity

🧠 Pathophysiology

Clonal B cells (lymphoplasmacytic lymphoma) → IgM accumulation in blood → ↑ serum viscosity

🩺 Clinical Features

- Anemia
- B symptoms: fever, weight loss, night sweats
- Hyperviscosity: headache, blurred vision, bleeding, ataxia
- Hepatosplenomegaly + lymphadenopathy

👁️ Fundus Exam

- Sausage-link retinal veins → dilated, segmented, tortuous veins

🧪 Bone Marrow Biopsy

- 10% monoclonal B lymphocytes with plasma cell features
- Intranuclear pseudoinclusions (IgM)

3️⃣ Monoclonal Gammopathy of Undetermined Significance (MGUS)

🧬 Immunoglobulin

- Any type: IgG, IgA, IgM
- M spike <3 g/dL

🩺 Clinical

- Asymptomatic (no CRAB)
- Low progression risk: 1–2% per year → MM

🧪 Bone Marrow

- <10% monoclonal plasma cells

📊 Comparison Table: Plasma Cell Dyscrasias

Feature	Multiple Myeloma	Waldenström Macroglobulinemia	MGUS
Ig Type	IgG > IgA > Light chains	IgM	Any
Clinical	CRAB	Hyperviscosity, neuropathy, B symptoms	Asymptomatic
Bone Marrow	>10% plasma cells	>10% lymphoplasmacytic B cells	<10% plasma cells
Urine	Bence Jones protein +	Usually negative	Usually negative
Risk	End-organ damage	Hyperviscosity complications	Low progression risk

🔁 High-Yield Flowchart (Text)

Clonal plasma cell expansion → Monoclonal Ig production (M spike)

- Blood accumulation → Hyperviscosity / CRAB
- Bone marrow infiltration → Anemia / marrow failure
- Light chain deposition → Renal failure
- Cytokine secretion → Osteoclast activation → Bone lesions 🦴

🎯 USMLE Pearls

- Rouleaux formation = multiple myeloma 🃏
- Bence Jones protein → urine electrophoresis required
- IgM macroglobulinemia → hyperviscosity → Waldenström
- MGUS → asymptomatic, may progress
- Bone pain + punched-out lesions → MM
- Sausage-link veins on fundus → Waldenström

-> The End <-