Bone Marrow Evaluation

A. **Overall Cellularity** - The fat to cell ratio is estimated on a particle block section. A normal marrow is approximately 50% fat and 50% hematopoietic cells with a range of 30-70% cellularity being normocellular.

   >70% cells - hypercellular; <30% cells - hypocellular; few cells - aplasia

B. A normal bone marrow has a **myeloid:erythroid (M:E) ratio** of about 3 or 4:1. Normal cellularity is described as 50%, therefore, in the marrow about 50% is fat, 40% is myeloid cells, and 10% is erythroid cells. (Myeloid ➔ granulocytic precursors; majority of precursors in a normal marrow).

**Examples of M:E ratio alterations:**
- ▼ M:E - erythroid hyperplasia (sickle cell or megaloblastic anemia, beta thalassemia major, H spherocytosis)
- ▲ M:E - granulocytic hyperplasia (chronic myelocytic leukemia)

M:E ratio is ~3:1 (normal) if all precursor cells are ▼ (aplastic anemia) or ▲ (primary polycythemia)

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![Bone Marrow Cells Table](https://example.com/bone-marrow-table)

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C. **Megakaryocyte Evaluation** - An average of one to three megakaryocytes per field should be found in a normal marrow being scanned under low power.

D. **Iron Stores** - Evaluation of iron in the marrow is done by staining a biopsy section or a bone marrow smear with Perl's Prussian Blue iron stain. Storage iron in the marrow is located in macrophages and the immature red cell cytoplasm, therefore it is normal to find a reserve of iron. •Increased stained iron occurs in sideroblastic anemia...may see ringed sideroblasts; •decreased stainable iron occurs in IDA. Can assess iron stores with serum ferritin level.

E. **Disease Diagnosis** - Bone marrows are used to diagnose many diseases, most commonly Aplastic anemia, Leukemias, Polycythemia vera, Lymphomas, Multiple myeloma, myelodysplastic syndromes. ●A bone marrow is indicated if malignancy is suspected, an unexplained cytopenia is present or if unable to determine if a reactive or malignant condition exists. (A marrow exam may be needed to diagnose certain cases of Megaloblastic anemia, Sideroblastic anemia, or anemia of chronic disease.)
**INDICATIONS FOR A BONE MARROW EXAMINATION**

The decision to perform a bone marrow is made on a case by case basis after correlation of clinical and laboratory findings.

- **Investigation of a peripheral blood abnormality** if cause cannot be determined by other means
  - Suspected blast cells, circulating lymphoma cells or other abnormal cells
  - All pancytopenic patients except those receiving recent bone marrow suppressive therapy
  - Significantly neutropenic or thrombocytopenic adults

- **Primary diagnosis** in patients with a likely hematologic disease including acute and chronic leukemia or multiple myeloma

- **Staging and management** of patients with certain types of neoplasms
  - Hodgkin’s and non-Hodgkin’s lymphoma
  - Some carcinoma types or other solid tumors

- **Ongoing monitoring** of response to therapy in patients with leukemia or other neoplasms

- **Evaluation** of patients with fever of unknown origin, unexplained splenomegaly or patients (adults) with infectious disease when diagnosis is not documented by other tests or marrow involvement is suspected