Chapter 1  ■  Normal Bone Marrow

Cellularity

Bone marrow cellularity and site alter throughout life as indicated in the figures and the table below.

Normal adult

Bone marrow in old age

Neonatal bone marrow

Bone Marrow Cellularity

<table>
<thead>
<tr>
<th>Age</th>
<th>Site</th>
<th>Cellularity (hemopoietic cells/fat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonate</td>
<td>All bones, liver, spleen</td>
<td>100/0</td>
</tr>
<tr>
<td>Child</td>
<td>Most bones</td>
<td>70/30</td>
</tr>
<tr>
<td>Adult</td>
<td>Axial skeleton</td>
<td>50/50</td>
</tr>
<tr>
<td>Old age</td>
<td>Axial skeleton</td>
<td>30/70</td>
</tr>
</tbody>
</table>
Cell Types Associated with the Bone

Cell Types Seen in Normal Bone Marrow

Hematopoietic Cells

In a good quality marrow section, especially if stained by the Giemsa method, most of the normal differentiated cell types can be identified: Granulocytes, erythroid cells, megakaryocytes, monocytes, macrophages, mast cells, lymphocytes, plasma cells and bone forming cells.
The reticulin in the bone marrow exists as a fine network. It is readily displayed by the Gomori’s Silver Stain and can be graded semi-quantitatively when abnormal as shown in the figures below.

Normal Bone Marrow

Grade 1. Focal fine reticulin. Normal. Gomori’s Silver Stain.


Grade 3. Diffuse fine reticulin, plus focal coarse reticulin. Abnormal. Gomori’s Silver Stain.

Grade 4. Diffuse coarse reticulin, including collagen, i.e. fibrosis. Abnormal. Gomori’s Silver Stain.
Erythroid colonies differentiate in the center of the marrow and frequently consist of small erythroid islands with central macrophage (immunostained for CD68 above).

Erythroid colonies are particularly well distinguished in Giemsa preparations by the distinct blueness of the erythroblasts (arrow).
A comparison of the features which may help discriminate between benign lymphoid aggregates in bone marrow and neoplastic involvement:

**Benign**
- Rounded aggregates
- Well-circumscribed, regular, small lymphocytes
- Elderly population
- < 3 mm in diameter
- Never paratrabecular
- Germinal centers (5% of cases)
- May contain plasma cells and eosinophils
- Polyclonal light chain expression
- 1–3 aggregates per trephine

**Neoplastic**
- May be irregular
- Cellular atypia may be present
- Wide age range
- May be > 3 mm diameter
- May be paratrabecular
- No germinal centers
- Usually just lymphoid cells
- Monoclonal light chain pattern
- > 3 aggregates per trephine

Mature megakaryocytes and their precursors are found uniformly distributed throughout the central region of the marrow, particularly in association with thin-walled venous sinuses.

**Lymphocytes**
Normal adult marrow contains an inconspicuous population of both B and T lymphocytes throughout the marrow. They may occur as small aggregates. These lymphoid aggregates increase in number with age, being frequently seen in the elderly population. If there are more than three lymphoid aggregates per trephine, it does suggest a neoplastic rather than a reactive process. Distinguishing between benign lymphoid aggregates and those which are neoplastic can be difficult and their significance remains unresolved (see table).