Lumbar Puncture Artifacts:
Bone Marrow Components, Cartilage Cells, etc.

If the patient’s spine is anatomically abnormal or is injured, or if the patient’s posture during the lumbar puncture is insufficiently relaxed, there is a greater likelihood that the lumbar puncture needle will strike against bone and that *bone marrow components* will be aspirated together with the CSF. Other cell types and tissues that may appear in the CSF as an artifact of lumbar puncture are *cartilage cells*, *skin cells*, *capillaries* and *subdermal connective tissue cells*. Capillaries of the plexus choroideus or of ventricle walls are occasionally seen in ventricular CSF.

Among the unintentionally aspirated *bone marrow cells*, the CSF cytologist may find the many different immature forms associated with *erythropoiesis* (ranging from proerythroblasts to normoblasts), *myelo- poiesis* (from myeloblasts to metamyelocytes), *monocytopoiesis* (from monoblasts to promonocytes), and *thrombocytopoiesis* (from megakaryoblasts to megakaryocytes). If these cell types are not recognized, they can easily be *misdiagnosed*, e.g., as neoplastic or tumor-suspect cells (cf. the tumor cell criteria in Chapter 5).

Examples of these immature forms are shown in Figures 2.10–2.15. Immature progenitor stages in the lymphocytic series are shown in Figure 2.16 and in some of the illustrations in other parts of this book dealing with infectious and inflammatory processes (see Chapter 3) and leukemic meningitis (Chapter 5, Leukemia). Typical cartilage cells are shown in Figure 2.17, and capillaries in ventricular CSF are shown in Figure 2.18.

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**Fig. 2.10** Promyelocytes in various stages of maturation (solid arrows) and an immature eosinophilic myelocyte (broken arrow).

**Fig. 2.11** Normoblast (solid arrow); myeloblasts (arrowheads); left, promyelocytes and eosinophil precursors; below right, two eosinophilic granulocytes (broken arrows) and a neutrophilic granulocyte with a band-shaped nucleus.
Fig. 2.12 Erythroblast (broken arrow); metamyelocyte (arrowhead); promyelocytes (solid arrows).

Fig. 2.13 Myelocyte and, below, a possible megakaryoblast (megakaryocyte?).

Fig. 2.14 Bone marrow components in the CSF as an artifact of lumbar puncture. Various precursor stages of hematopoiesis are seen: promyelocytes in different stages of maturation; polychromatic normoblasts (single cells and two nests of cells); orthochromatic normoblasts as individual cells and nests of cells.
Fig. 2.15 Progenitor cell (arrow), possibly of the monocytic (hematogenous phagocytic) lineage, in a patient with subarachnoid hemorrhage past the acute stage. There are also two erythro-hemosiderophages containing considerable amounts of lipid (other bone marrow cells were found in the remainder of the cytological preparation).

Fig. 2.16 Progenitor stage of a plasma cell in amitotic division. This cytological preparation also contained other bone marrow cells.

Fig. 2.17 Cartilage cells, single and in a cluster: coarsely structured, round to oval nucleus, large and deeply stained cytoplasmic areas with color alternating between blue and red. For size, compare with the neighboring erythrocytes.

Fig. 2.18 Capillaries (from the choroid plexus or the ventricle walls) in ventricular CSF obtained through an external drain after a neurosurgical procedure. Elongated endothelial cells with a typical oval nucleus are seen.