Case History for BMD-08 – BMD-13

This bone marrow aspirate smear is from a 45-year-old man transferring from an outside hospital with new onset of an acute leukemia. Laboratory values: WBC = 43.5 × 10E9/L; RBC = 2.57 × 10E12/L; HGB = 8.9 g/dL; HCT = 25.3%; MCV = 99 fL; and PLT = 45 × 10E9/L.

(BONE MARROW, WRIGHT-GIEMSA)

Please click on the hyperlink below to view the DigitalScope images for this case. Click on the "i" icon for each region of interest (challenge) to view the text that is found in the Participant Summary Report (PSR).

http://www.digitalscope.org/LinkHandler.axd?LinkId=3856fd6a-d67d-4a0a-aaa8-026d50796b88

To access the online Hematology Glossary, please click the hyperlink below:
http://www.cap.org/ShowProperty?nodePath=/UCMCon/Contribution%20Folders/WebContent/pdf/hematology-glossary.pdf

Summary of Participant Survey Results

The following is a statistical summary of all results submitted by participating laboratories. These are provided to allow participants to see their responses in the context of their peers. These results may identify findings or topics for further education or review. Survey results are not intended to represent the correct or desired responses for proficiency testing purposes and the SD and CV should not be interpreted as acceptable reporting limits. Participants are encouraged to review discrepant results with their medical director.

Bone Marrow Differential – %

		NO. LABS	MEAN	S.D.	C.V.*	Median	Low Value	High Value
BMD-08	Blasts	260	78.18	19.88	25.4	84.8	1.0	97.0
	Promyelocytes	243	0.58	1.26	*	0.0	0.0	9.6
	Myelocytes	254	1.39	1.46	*	1.0	0.0	7.0
	Metamyelocytes	246	0.67	0.76	*	0.5	0.0	3.0
	Band/Segmented Neutrophils	266	1.94	1.13	58.2	2.0	0.0	5.2
	Eosinophils (all stages)	262	1.62	1.26	77.6	1.4	0.0	5.0
	Basophils	241	0.00	0.00	0.0	0.0	0.0	0.0
	Monocytes	255	3.37	4.48	*	1.8	0.0	20.6
	Lymphocytes	269	3.52	2.67	76.0	3.0	0.0	16.0
	Plasma cells (normal and abnormal)	265	1.46	0.87	59.3	1.0	0.0	4.1
	Erythroid precursors (all stages)	267	2.27	4.67	*	1.0	0.0	45.0
	Other	183	0.16	0.90	*	0.0	0.0	8.2
	Myeloid : Erythroid ratio	202	49.99	35.84	71.7	46.8	0.0	99.9

* When low results are reported on an analyte, a high coefficient of variation (CV) may result. When the mean value is very low the C.V. may be exaggerated.

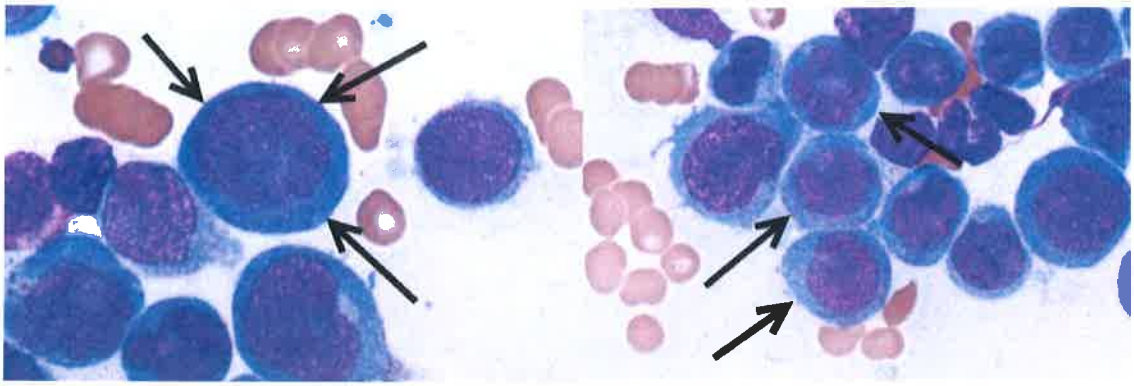
	Other cells not listed:	Total (N=16)
BMD-08	Promonocytes/monoblasts	8
	Erythroblasts	3
	Mitotic figures	3
	Atypical mononuclear cell	1
	Macrophage	1

Committee Comments on the Bone Marrow Aspirate

This case is an example of acute myeloid leukemia. The bone marrow aspirate shows an increased number of blasts comprising about 95% of total cellularity. These blasts are large, round to oval cells and have round to oval nuclei with fine chromatin and prominent nucleoli. The cytoplasm is variably basophilic and agranular. The normal marrow elements are markedly decreased.

Cell Identification

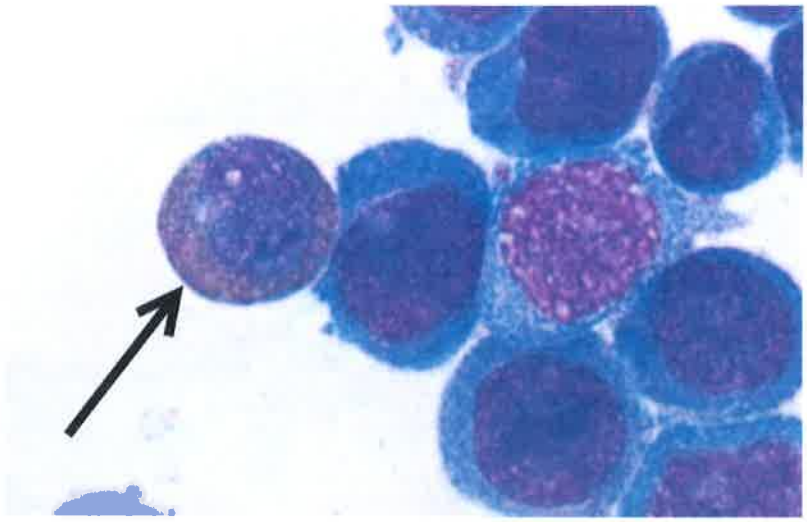
BMD-09



Identification	Participants No.	Participants %	Evaluation
Blast cell (includes lymphoblast)	162	57.9	Educational
Monocyte, immature (promonocyte, monoblast)	88	31.4	Educational
Erythrocyte precursor, normal (includes pronormoblast, basophilic, polychromatophilic, and orthochromic normoblasts)	8	2.9	Educational
Erythrocyte precursor, abnormal/dysplastic nuclear features (includes pronormoblast, basophilic, polychromatophilic, and orthochromic normoblasts)	6	2.1	Educational
Neutrophil, promyelocyte	4	1.4	Educational
Immature or abnormal cell, would refer for identification (Code 108 should be used only if you would routinely send the cell in question to an outside laboratory with another CLIA number)	3	1.1	Educational
Megakaryocyte or precursor, abnormal	3	1.1	Educational
Myeloblast with Auer rod	2	0.7	Educational
Neutrophil, promyelocyte, abnormal with/without Auer rod(s)	2	0.7	Educational
Monocyte	1	0.4	Educational
Neutrophil, myelocyte	1	0.4	Educational

The arrowed objects are blasts, as correctly identified by 57.9% of participants. About 31.4% of participants answered as monocyte, immature which includes monoblasts. A blast is a large, round to oval cell, 10 - 20 µm in diameter. The nuclear-to-cytoplasmic ratio is high, varying from 7:1 to 5:1. The blast often has a round to oval nucleus, but sometimes it is indented or folded; and it has fine, lacy or reticular chromatin. One or more prominent nucleoli may be seen. The cytoplasm is variably basophilic and typically agranular. The morphologic features of a blast cell do not permit determination of the cell lineage, ie, myeloblast versus lymphoblast. The one exception is the presence of Auer rods, which are diagnostic of myeloid lineage (ie, myeloblast). In the absence of Auer rods, immunophenotyping by flow cytometry, immunohistochemistry on tissue sections, or, less commonly, cytochemical staining (eg, peroxidase or Sudan black B reactivity) is required to determine the lineage of a given blast cell. Additionally, blasts can be morphologically indistinguishable from lymphoma cells. For identification purposes, one should classify individual cells exhibiting this type of morphology as blast cells when additional confirmatory information is unavailable.

BMD-10

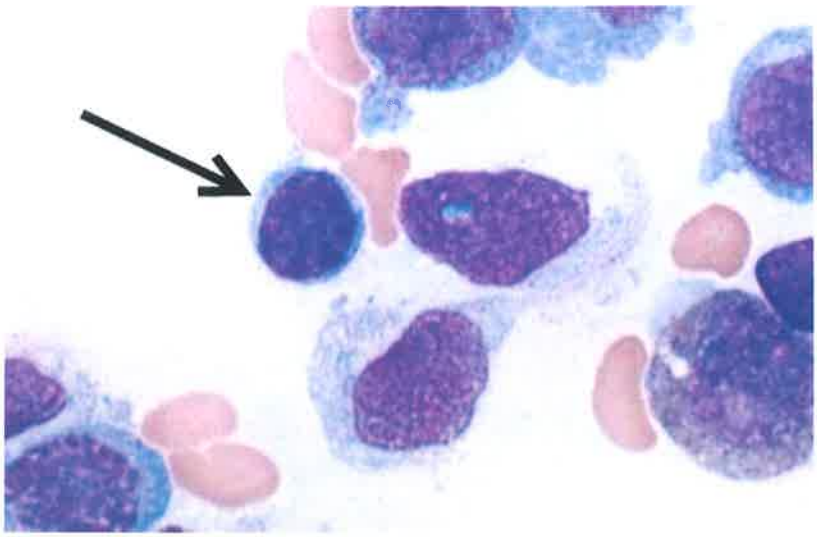


Identification	Participants No.	%	Evaluation
Eosinophil, any stage	208	74.3	Educational
Neutrophil, myelocyte	53	18.9	Educational
Eosinophil, any stage with atypical/basophilic granulation	14	5.0	Educational
Neutrophil, promyelocyte	2	0.7	Educational
Blast cell (includes lymphoblast)	1	0.4	Educational
Erythrocyte precursor, abnormal/dysplastic nuclear features (includes pronormoblast, basophilic, polychromatophilic, and orthochromic normoblasts)	1	0.4	Educational
Monocyte	1	0.4	Educational

The arrowed object is an eosinophil, as correctly identified by 74.3% of participants. Eosinophils are the same size as neutrophilic cells, 10 - 15 µm for mature forms and 10 - 18 µm for immature forms. The N:C ratio ranges from 1:3 for mature forms to 2:1 for immature forms. Their abundant cytoplasm is generally evenly filled by numerous coarse, orange-red granules of uniform size. These granules rarely overlie the nucleus and exhibit a refractile appearance with light microscopy due to their crystalline structure. The uniform, coarse nature of eosinophilic granules is characteristic and differs from the smaller, finer granules of neutrophilic cells. Occasionally, eosinophils can become degranulated with only a few orange-red granules remaining visible within the faint pink cytoplasm. In the most mature eosinophilic form, the nucleus segments into two or more lobes connected by a thin filament. About 80% of segmented eosinophils will have the classic two-lobed appearance. Typically, these lobes are of equal size and round to ovoid or potato-shaped with dense, compact chromatin. The remainder of segmented eosinophils will have three lobes, and an occasional cell will exhibit four to five lobes. Eosinophils exhibit the same nuclear characteristics and the same stages of development as neutrophilic leukocytes. Immature eosinophils are rarely seen in the blood, but they are found in bone marrow smears. They may have fewer granules than more mature forms. The earliest recognizable eosinophilic form by light microscopy is the eosinophilic myelocyte. Eosinophilic myelocytes often contain a few dark purplish granules in addition to the orange-red secondary granules.

About 18.9% of participants incorrectly answered as neutrophil, promyelocyte and 5.0% of participants incorrectly answered as eosinophil, any stage with atypical/basophilic granulation. The cytoplasm of a promyelocyte is basophilic and contains multiple distinct azurophilic (primary) granules. A paranuclear hof or cleared space is typically present. The atypical/basophilic granules are purple-violet in color and usually larger than normal eosinophilic granules. These granules are absent in the arrowed cell.

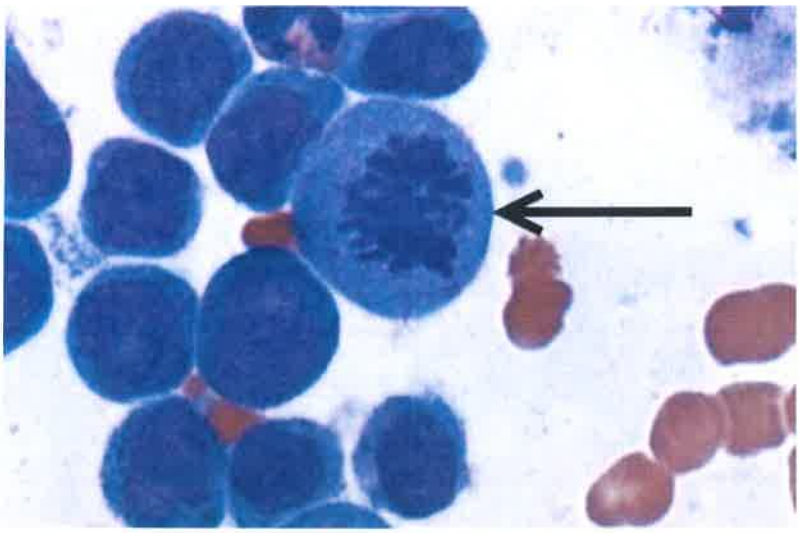
BMD-11



Identification	Participants No.	%	Evaluation
Lymphocyte	280	100.0	Educational

The arrowed object is a lymphocyte, as correctly identified by 100.0% of participants. Small lymphocytes are usually only slightly larger than erythrocytes and contain a round to oval nucleus with clumped chromatin and relatively scant lightly basophilic cytoplasm. Small lymphocytes usually have an inconspicuous nucleolus.

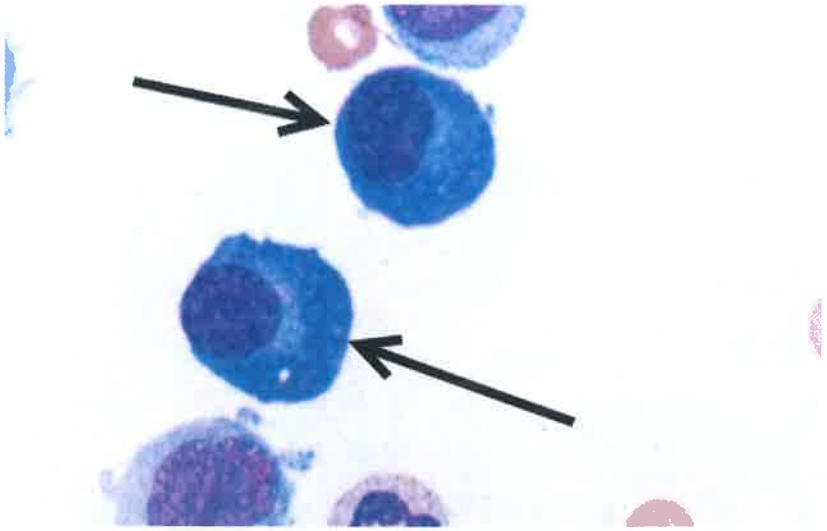
BMD-12



Identification	Participants No.	%	Evaluation
Mitotic figure	274	97.9	Educational
Erythrocyte precursor, abnormal/dysplastic nuclear features (includes pronormoblast, basophilic, polychromatophilic, and orthochromic normoblasts)	4	1.4	Educational
Erythrocyte precursor, normal (includes pronormoblast, basophilic, polychromatophilic, and orthochromic normoblasts)	1	0.4	Educational
Neutrophil necrobiosis (degenerated neutrophil)	1	0.4	Educational

The arrowed object is a mitotic figure, as correctly identified by 97.9% of participants. A cell containing a mitotic figure is variable in size; it may or may not be larger than the surrounding cells. The cytoplasm has the color and granulation characteristics of the resting cell. When a cell undergoes mitosis, typical nuclear features are no longer present. Instead, the nucleus appears as a dark, irregular mass, often with a clear central zone. It may take various shapes, including a daisy-like form or a mass with irregular projections. In metaphase, the individual chromosomes become visible; arranged equatorially, they begin to separate and to move toward opposite poles. Rarely, the anaphase or telophase of mitosis may be seen, with two separating masses of chromosomes forming two daughter cells. A mitotic cell can be distinguished from a degenerating cell by a relatively compact nucleus (or nuclei) in the latter; a degenerating cell often displays a pyknotic nucleus that has been fragmented into numerous purple, roundish inclusions. Although the bone marrow is normally a rapidly dividing tissue, only small numbers of mitoses are found in normal marrow aspirates.

BMD-13



Identification	Participants No.	%	Evaluation
Plasma cell (to include morphologically mature, abnormal, and containing inclusion, eg, Dutcher body, Russell body, etc)	280	100.0	Educational

The arrowed objects are plasma cells, as correctly identified by 100.0% of participants. Plasma cells represent terminally differentiated B-lymphocytes. They range in size from 10 - 20 µm, and they are often oval-shaped with relatively abundant cytoplasm and eccentrically located nuclei. The N:C ratio is 1:2. Their nuclei are usually round to ovoid with prominently coarse and clumped chromatin that is often arranged in a cartwheel-like or clock-face pattern. Occasional benign plasma cells are binucleated. Nucleoli are absent. The cytoplasm stains gray-blue to deeply basophilic. A prominent hof or perinuclear zone of pale or lighter staining cytoplasm is typically seen adjacent to one side of the nucleus. This area corresponds to the Golgi zone, which is prominent in cells that produce large amounts of protein, such as immunoglobulin in the case of plasma cells. Cytoplasmic granules are absent, and scattered vacuoles of varying size may be seen.

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