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Clinical Study of Bone Marrow by the Method of Sternal Puncture.

W. F. HOLMES AND G. O. BROUN.

From the St. Louis University Medical School.

The material was secured by sternal puncture by a technique similar to that of Arinkin.[1] More than 50 cases were used representing a wide variety of clinical conditions. Smears made from the marrow material were stained with Wright's stain, Cresyl blue reticulocyte stain, Giemsa stain and peroxidase stains, no variations in technique being made from that of peripheral blood smears. This report is limited to a discussion of the Wright stained preparations.

The marrow cells are well-preserved and stained. Differential counts of the marrow cell elements have been made. The average of 7 cases with a normal peripheral blood picture was the following cells: Myeloblasts 2.4%; myelocytes 7%; Jung Kernige 6.7%; Stag Kernige 14%; II Segment Neutrophiles 10%; III Segment Neutrophiles 6.3%; IV, V, etc., Segment Neutrophiles 1.1%; Eosinophiles 1%; Basophiles 0.3%; Monocytes and Reticulo-endothelial elements 9%; Lymphoid Cells 24.9%; Megaloblasts 5.2%; Normoblasts 6.9%; Primitive Cells 2.6%. These findings agree rather closely with those of Arinkin[1] on similar types of cases.

The high percentage of immature granulocytes in our counts confirms the concept of Arneth and Schilling that the neutrophilic nucleus changes progressively with age from the round to the segmented form. The high percentage of juveniles and stabs confirms the idea that these are "young" granulocytes.

Cells indistinguishable by Wright's stain from the lymphocytes of peripheral blood are present in practically all of our bone marrow preparations. These we have designated as lymphoid cells. Certain small primitive cells and young myeloblasts[2] may be included in this group. The percentage of lymphoid cells is definitely greater than would be expected from the possible contamination with lymphocytes of peripheral blood. We have not attempted a separation of lymphoblasts from myeloblasts in the Wright stain preparations—all are termed myeloblasts except in the case of lymphatic leukemia. Mitotic divisions of cells in the bone marrow smears is largely limited to an intensely basophilic cell which varies in morphology both

[1] Arinkin, M. J., *Klin. Med.*, 1929, **7**, 135.

[2] Isaacs, Raphael, *Arch. Int. Med.*, Dec., 1932.

from the typical myeloblast and the typical megaloblast. It is a larger cell than those we have termed "Lymphoid cells". This cell we have called the primitive cell in our differential counts. Occasional mitotic division is seen in hemoglobin-containing erythroblasts.

Schilling[3] classes the appearance of megaloblasts in bone marrow as hyper-regeneration and as indicative of failure of normal regeneration. Our counts show large numbers of typical megaloblasts in all stages of development. In no instance are they completely absent. The megaloblastic marrow of the untreated cases of pernicious anemia is in our series marked by an increase in the primitive cells and very early megaloblasts rather than by an increase of the more mature hemoglobin-containing forms. Myeloblasts 6.5%; Myelocytes 9.6%; Jung Kernige 6.5%; Stab Kernige 10.0%; II Segment Neutrophiles 7.5%; III Segment Neutrophiles 3.0%; IV, V, etc., Segment Neutrophiles 1.5%; Eosinophiles 2.5%; Monocytes and Reticulo-endothelial elements 16%; Lymphoid cells 21.5%; Megaloblasts 7.5%; Normoblasts 8.0%; Primitive cells 7.0%.

The marrow of lymphatic leukemia shows marked alteration from the normal picture in that abnormal lymphocytic cells far outnumber all other cell types. The following differential illustrates this point: Lymphocytes 4.5%; Lymphoblasts 90.0%; Megaloblasts 2.5%; Normoblasts 1.0%; Primitive cells 2.0%.

The marrow of myeloid leukemia shows an increase of myeloblasts and myelocytes: Myeloblasts 14.0%; Myelocytes 11.0%; Jung Kernige 14.0%; Stag Kernige 12.0%; II Segment Neutrophiles 11.0%; III Segment Neutrophiles 5.0%; IV, V, etc., Segment Neutrophiles 1.5%; Eosinophiles 2.0%; Basophiles 1.0%; Monocytes and Reticulo-endothelial elements 5.0%; Lymphocytes 10.0%; Normoblasts 1.0%; Primitive cells 1.5%.

One atypical leukemia shows a mixed marrow picture with many lymphocytes and erythroblasts: Myeloblasts 5.0%; Myelocytes 13.5%; Jung Kernige 1.5%; II Segment Neutrophiles 3.5%; III Segment Neutrophiles 0.5%; Monocytes and Reticulo-endothelial elements 0.5%; Lymphocytes 30.0%; Megaloblasts 6.5%; Normoblasts 27.5%; Primitive cells 8.5%.

A single case of aplastic anemia showed a marked decrease in erythroblasts and granulocytic cells but on the other hand showed a

[3] Schilling, Victor, The Blood Picture, 106. (Translated by R. B. H. Gradwohl.)

marked increase in primitive cells, myeloblasts and lymphocytes: Myeloblasts 22.0%; Myelocytes 7.0%; Jung Kernige 1.0%; Stab Kernige 1.0%; II Segment Neutrophiles 3.0%; Monocytes and Reticulo-endothelial elements 4.0%; Lymphocytes 42.0%; Megaloblasts 2.0%; Normoblasts 1.0%; Primitive cells 17.0%.

It is obvious that the method of sternal puncture secures a specimen from only one small part of the extensive marrow system. Hence it is not surprising that variations seen by examining sections from many portions of the marrow may not be reflected in the sternal specimen. However, when the marrow is altered throughout its extent, alterations in the sternal marrow are to be expected.

The sternal puncture method is excellent for comparison of peripheral blood and marrow cell morphology. For clinical diagnosis it will only occasionally be useful.

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Effect of Urea upon Activity of Bacteriophage.*

J. BRONFENBRENNER AND D. M. HETLER.

From the Department of Bacteriology, Washington University Medical School.

In attempting to minimize denaturation of phage by heat we employed a number of substances which various investigators have found to prevent denaturation of proteins.[1] While some of these substances delayed denaturation of phage (saccharose, glycerine and to lesser extent $CaCl_2$ or glucose) other substances (sodium salicylate, Bayer 205, or urea) exhibited no gross protective effect. During these experiments it was noted, however, that when mixtures containing phage and urea were plated with homologous bacteria at intervals during the experiment (before the inactivation of phage has occurred) the plaques of lysis appeared to be larger and noticeably clearer than on control plates containing the phage without the addition of urea. This apparent intensification of lysis in the presence of urea suggested the possibility that addition of urea may perhaps bring out the lytic activity of phage under circumstances where lysis is ordinarily inhibited, as for instance on 4%

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[1] Bronfenbrenner, J., PROC. SOC. EXP. BIOL. AND MED., 1932, **29**, 802.