10568 P

Human Sternal Marrow in Hyperthyroid and Myxedematous States.

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In a recent comprehensive review of observations made on the bone marrow in states of thyroid dysfunction Bomford[1] concludes that the scanty evidence available indicates a partial atrophy of the marrow in hypothyroidism. In hyperthyroidism there is first an increased activity, and then a scarcity of hemopoietic marrow cells. He believes that diminished oxygen requirements of all the tissues and consequent lack of stimulation to erythropoiesis, in hypothyroidism causes a quantitative hypoplasia of active marrow. This belief is based on postmortem findings in cretins[2-6] and studies of rabbit marrow after thyroidectomy.[7, 8] The hyperthyroid marrows were obtained from rabbits after the feeding of thyroid or injection of thyroxine.[9, 10]

I am reporting the results of studies of the aspirated sternal marrow of humans in "normal", hyperthyroid, and myxedematous states. The method[11] of obtaining and studying the marrow has been in use at the University of Illinois for over 20 months and to date over 700 aspirations have been done in a wide variety of conditions. The technic and apparatus used in the above method were recently reported in detail.[12]

Aspirated sternal marrow from 18 individuals with normal peripheral blood picture and no complaints other than a hernia in several, contained an average of 6.2% (ranging from 4 to 10%) of nucleated cells. Stained smears of these nucleated cells revealed

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that the ratio of myeloid to erythroid cells fell between 2:1 and 4:1.

Marrow taken in the same way from 12 individuals in a hyperthyroid state contained an average of 13.5% (7% to 22%) nucleated cells with a myeloid-erythroid ratio in the stained smears running from 5 to 1 to as high as 20 to 1. There was also an apparent marked increase in the megakaryocytes found in these smears when compared with the "normals".

Marrow taken from 7 myxedematous individuals contained an average of 2.4% nucleated cells (ranging from 1.5% to 4%) and the myeloid-erythroid ratio varied from 1:1 to 3:1.

The aspirated sternal marrow of 6 of the 7 in a myxedematous state was studied subsequent to the feeding of desiccated thyroid or injection of thyroxine and in all cases a marked rise in the percentage of nucleated cells in the marrow was found. This change varied in magnitude. There was a rise from 1.5% to 3% in 4 weeks in one case, and from 2% to 14% after 3½ months in another. This increase was accompanied by a rise in the basal metabolic rate and a fall in the blood cholesterol.

One individual with a thyrotoxicosis due to the ingestion of desiccated thyroid had 20% nucleated cells in the aspirated marrow when her basal metabolic rate was +150%.* This fell to 12% two months later, at which time her basal metabolic rate was +4%, and to 6% nucleated cells six months after the thyroid ingestion was stopped. Following sub-total thyroidectomy all marrows studied showed a less marked but consistent decrease.

Peripheral blood studies were done at the time of marrow aspiration in all cases. In the hyperthyroid individuals, a most interesting fact was that there was no reflection of the myeloid hyperplasia of the marrow in the peripheral blood. All 7 in the hypothyroid state were somewhat anemic. Five had an average red cell volume within normal limits, while one was macrocytic (106 cu microns), and one had a frank iron-deficiency anemia (67 cu microns).

Sternal marrow aspirated from individuals in a state of thyrotoxicosis shows a marked myeloid hyperplasia when compared to that of "normals". The average percentage of nucleated cells found in hyperthyroidism is over twice the "normal" average. This myeloid hyperplasia contrasts sharply with the erythroid type of most anemias, and in over 700 marrow biopsies, most closely resembles that found in chronic myelogenous leukemia. The myeloid hyperplasia of the sternal marrow is not reflected in the peripheral blood,

* Average of two tests done after rest and sedation. Patient was restless and these probably are not true basal rates.

as is usually the case in myelogenous leukemia. In the small number of cases studied the myeloid hyperplasia tends to return to "normal" when the thyrotoxicosis is removed.

Aspirated sternal marrow from individuals in a myxedematous state is markedly hypoplastic. Sufficient feeding of desiccated thyroid or injection of thyroxine causes an increase in the nucleated cells of this marrow to "normal".

These findings indicate that the thyroid secretion has a regulatory effect on quantity and quality of the bone marrow, as evidenced by differences found in the quality and quantity of aspirated sternal marrow.

10569 P

The Adrenals in Experimental Hypertension.

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In preliminary experiments by Goldblatt,[1] bilateral adrenalectomy in dogs appeared to interfere with the development or maintenance of the hypertension which follows experimental production of renal ischemia. Similar results were obtained by Blalock and Levy[2] and by Page.[3] On the other hand, Collins and Wood[4] concluded that, "It is unlikely that the adrenal cortex is involved specifically in the etiology of experimental renal hypertension other than in the sense that the cortex is important in the maintenance of blood pressure in normal as well as in hypertensive states."

Our experiments show that this form of experimental hypertension can exist in the complete absence of the adrenal glands, in untreated animals. Seven dogs were subjected to complete bilateral adrenalectomy in addition to constriction of the main renal arteries by means of Goldblatt clamps. Four of these animals were treated

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2 Blalock and Levy, *Ann. Surg.*, 1937, **106**, 826.

3 Page, *Am. J. Physiol.*, 1938, **122**, 352.

4 Collins and Wood, *Am. J. Physiol.*, 1938, **123**, 224.