GLUTATHION IN ANÄEMIAS

Its Variations in the Blood and Its Relation to the Erythrocyte Count and Hæmoglobin Content

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Anæmia signifies a blood condition in which the number of red cells, the total volume of cells and the quantity of haemoglobin are decreased considerably owing to an imbalance between processes of destruction and replacement (Wiggers). Most of the investigations on anæmias are concerned with the formed elements of the blood. The biochemical investigations of the blood in anæmias are confined to the study of the physical and chemical characters and fate of the blood pigment. Glutathion is one of the important constituents of the erythrocyte, susceptible to variations in blood diseases.

The blood glutathion is entirely confined to the erythrocytes; the variations in its values in most of the pathological conditions, even in cystinuria, are within normal limits; in liver diseases the variations are wide; and in anæmias and some cyanotic conditions the ratio of glutathion to erythrocytes is increased (Platt, 1931). Rabbits rendered anemic after successive bleedings show an increase in blood glutathion per unit volume of red cells associated with the decrease in cell volume (Litarczek et al., 1931). Generally when cell volume is low in anæmic cases, the whole blood reduced glutathion is reduced below normal mean and the figure per 100 c.c. cells is high; the opposite is true in polycythemic cases (Bowman, 1934).

In rabbits rendered anemic by bleeding or by administration of phenyl hydrazine, the glutathion content of the whole blood is decreased and that of the erythrocyte is increased (Besozzi and Zanini, 1935). Corpuscular glutathion is increased in anæmias but decreased in polycythemias; the increase in post-hæmorrhagic and acute infectious anæmias being not well marked (Ddogliotti and Castellani, 1935).

In rats suffering from experimental nutritional anæmia the total glutathion of the erythrocyte is decreased, there being a marked shift towards the oxidised form. In pigs under similar experimental conditions, there is an increase in both forms of glutathion in the erythrocyte as the anæmia becomes
severe. This difference is possibly due to the appearance of reducing substances other than glutathion in the blood of pigs or other animals during anæmia. The blood glutathion concentrations return to normal with the feeding of copper and iron (Schultze and Elvehjem, 1936).

The observations of several authors on the variation of glutathion in blood, lead one to infer that the blood glutathion, the erythrocyte count, and cell volume, are all interrelated. The occurrence of high corpuscular glutathion in pernicious anæmia and myelogenous leukaemia when the erythrocytes are megalocytic and hyperchromic (Schultz, 1939) justifies such an inference. But the observations of Kandel and LeRoy (1939) that the variations of blood glutathion cannot be correlated with either erythrocyte and leukocyte counts or haemoglobin concentration or cell volume indicate that there are no grounds for such an inference. We have examined the blood of anæmic patients with respect to the glutathion content, erythrocyte count and haemoglobin concentration with a view to arriving at any correlation that may exist.

The results of the investigation are embodied in Tables I and II. The blood counts range from 0.51 to 5.03 millions per mm.³, haemoglobin from 2.3 to 14.8 gm. per 100 c.c. of blood and the colour index from 0.59 to 2.29. The average figures for reduced and oxidised glutathion are 21.39 and 4.60 mgm. per 100 c.c. blood. Gabbe's quotient and the modified Gabbe's quotient range from 4.1 to 27.7 and 1.9 to 9.5 with averages at 10.6 and 4.6 respectively.

Table III is an analysis of Tables I and II and gives the average values of the erythrocyte count, the reduced and oxidised glutathion content, the Gabbe's quotient for subjects suffering from various diseases causing anæmia. For ready reference the corresponding figures for healthy subjects are included in the same table. The average figure for Gabbe's quotient indicates a high corpuscular glutathion content in anæmia. It is the highest for ankylostome anæmias.

Fig. 1 shows that the variations of Gabbe's quotient with the erythrocyte count tend to be high with low cell counts. Fig. 2 shows that the variations of the modified Gabbe's quotient with the erythrocyte count tend to be confined to a narrow limit.

The results of the present study indicate that in human anæmias the corpuscular glutathion is increased more than normal as is evidenced by a high Gabbe's quotient. Though the whole blood glutathion content is within the observed limits for healthy individuals, the average values for reduced and oxidised glutathion show a slight decrease.