Red Cell Life Span in Acclimatization to Altitude. (21299)

C. REYNAFARJE, N. I. BERLIN, AND J. H. LAWRENCE.

From the Section on Research Medicine, Donner Laboratory, University of California, Berkeley, and Instituto de Biologia Andina, Lima, Peru.

It is well known that individuals going from sea level to higher altitude develop a secondary polycythemia, the level to which the total red cell volume rises being a function of the altitude(1,2). Two mechanisms can be postulated for the development of this polycythemia, the first is an increase in the rate of formation of red cells, and the second an increase in the life span of the red blood cell or possibly a combination of both. Earlier studies using radioactive iron demonstrated conclusively that there is an increase in the rate of production of red cells when individuals go from sea level to 14,900 feet(2). However, these studies did not exclude the possibility that some alteration in the red cell life span occurred so that the total red cell volume would increase both as a result of increased production and an increased life span of the red cell. In the rat, no change in red cell life could be demonstrated during the period of acclimatization to a simulated altitude of 15,000 feet(3). Studies were undertaken using Carbon-14 labelled glycine of the life span of the red blood cell of individuals going from sea level to 14,900 feet.

Methods. Six individuals normally living at sea level were taken to 14,900 feet, 4 hours being required to reach altitude, and then 10 hours after arrival at 14,900 feet, given 100 μc of glycine 2-C-14 intravenously for determination of the life span of the red blood cell according to the method of Shemin and Rittenberg(4). Blood samples were drawn at frequent intervals and the hemoglobin extracted by modification of the method of Drabkin (5,6). The hemoglobin was converted to CO_2 by the method of Van Slyke and Folch(7), and the radioactivity determined in a 100 cc ionization chamber at atmospheric pressure using a vibrating reed electrometer and recording potentiometer to measure the rate of voltage change in the ionization chamber(8).

TABLE I. Hematological Data at Sea Level and after 10 Days at 14900 Feet, in 6 Subjects.

	Age	Hematological data (sea level) R.B.C.	Hgb.	Hct.	Hematological data after 10 days at 14900 feet R.B.C.	Hgb.	Hct.
		M			M		
S.P.	22	5.30	16.5	48.0	6.10	18.5	54.6
J.R.	21	5.17	15.7	48.0	6.00	18.5	55.4
O.M.	20	5.33	16.5	49.0	6.32	19.5	59.1
A.C.	20	4.73	14.7	45.0	5.46	17.1	52.0
A.M.	22	5.22	16.4	50.4	6.20	19.3	57.4
L.S.	20	4.86	15.1	46.9	6.33	18.2	56.9

Results. Table I shows the pertinent hematological data in these individuals. The graph depicting the change in C-14 concentration in the hemoglobin of these individuals is shown in Fig. 1. This figure shows that the life span of the red blood cell varies from 111 to 121 days in these individuals and is normal.

Discussion. The observation of an increased red blood cell count, hemoglobin and hematocrit and an increased total red cell volume in the polycythemia secondary to low oxygen tension is thus shown to be exclusively

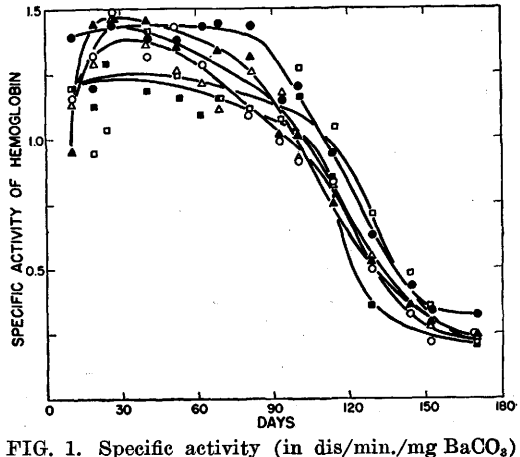

FIG. 1. Specific activity (in dis/min./mg $BaCO_3$) of hemoglobin.

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the result of an increase in the rate of production and not to be due to any alteration in the life span of the red blood cell.

Summary. Six individuals taken from sea level to 14,900 feet showed a normal red cell life span during the period of acclimatization; therefore, the polycythemia secondary to altitude is due entirely to an increase in the rate of red cell formation.

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Distribution of Glycoproteins in Normal Human Plasma.* (21300)

HENRY E. WEIMER, JEAN REDLICH-MOSHIN, DAVID SALKIN, AND RUTH A. BOAK.
(Introduced by Charles M. Carpenter.)

From the Departments of Infectious Diseases and Medicine, School of Medicine, University of California, Los Angeles, and VA Hospital, San Fernando, Calif.

The glycoproteins† of plasma are a heterogeneous group of conjugated proteins consisting of peptides in firm union with polysaccharides. Their occurrence, chemistry, significance, and methods for determination have been reviewed by Winzler(1). Due to the complex fractionation procedures required for the isolation of individual glycoproteins (2-4), the most generally employed method for the estimation of the protein-bound carbohydrate of plasma is the determination of total plasma glycoprotein. Although such determinations have yielded valuable data on the levels of plasma glycoproteins in many physiologic and pathologic conditions, they provide no information on the distribution of the protein-bound carbohydrate among the protein fractions present in blood plasma.

In the present investigation data obtained from the analyses of fractions isolated by a low temperature-low salt-ethanol procedure (5) from normal human plasma are correlated with the results of the more widely employed total plasma glycoprotein and seromucoid determinations.

Materials and methods. Plasma. Seventeen ml of blood were obtained by venipuncture from 10 male and 10 female donors in apparent good health and varying in age from 21 to 45 years. The blood was immediately added to 3 ml of A.C.D. solution(5). Following separation by centrifugation from the blood cells, the A.C.D. plasma was stored at −20°C until the fractionations and the chemical determinations could be conducted. *Fractionation.* Five ml aliquots of A.C.D. plasma were fractionated by the low temperature-low salt-ethanol procedure of Lever and associates (5). The separations were carried out in a −5°C bath containing 50% by volume of ethanol and equipped with an effective stirrer. Precipitates were recovered by centrifugation at −5°C. *Chemical analyses.* Fractions I + III, II, and VI were dissolved and made up to 10 ml and Fraction IV + V was dissolved and made up to 25 ml with the same reagents employed by Lever *et al.*(5). The protein-bound carbohydrate (hexose) content of the plasma fractions was determined as follows. One-ml

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†Terminology employed is in accord with the recent suggestions of Winzler(1). The term "total plasma glycoprotein" has replaced "total plasma polysaccharide" and "seromucoid" has been substituted for "mucoprotein."