Abstract

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Polycythemia and Erythropoietic Activity in Humans at Extreme Altitudes

William Siri

and

Charles Webster

The many observations on hematologic values associated with secondary polycythemia in persons acclimatized to low barometric pressure show that RBC, Hct, and Hgb increase uniformly with altitude. Direct studies of red cell volume and erythropoietic activity, however, have been made only at the single altitude of 14,900 ft. While it may be inferred from these studies and the response in relative hematologic values that erythropoietic activity also increases uniformly with altitude between sea level and 15,000 ft., there is reason to believe that the response may be different for still higher altitudes. In order to test this contention, as well as to establish the level of erythropoietic activity at intermediate altitudes, studies were conducted on residents at 12,500 ft. and at 17,000 ft., the highest altitude of sustained human habitation. The study included determinations of P^{32} red cell volume, plasma volume and plasma iron turnover rate with radio-

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iron, blood gases, the standard hematologic values, and tritium space. The work was conducted at La Paz, Bolivia (12,500 ft.) and at the high altitude Cosmic Ray Laboratory at Chacaltaya, Bolivia (17,000 ft.). The results obtained on residents at 12,500 ft. are consistant with earlier findings at 14,900 ft. in the sense that red cell volumes and erythropoietic activity observed at these two altitudes appear to be proportional to the altitude. The red cell volume and plasma iron turnover rates observed in residents at 17,000 ft., however, are substantially higher than can be accounted for by the normal increase with altitude seen at lower elevations. Our observations suggest that an abrupt increase in erythropoietic activity occurs between 15,000 and 17,000 ft.

If hyperstimulation of erythropoiesis at extreme altitudes is confirmed, several hypotheses on the nature of the response may be advanced.

Erythropoietin, which can stimulate a very high level of activity, is not found in the plasma of normal persons, either at sea level or 15,000 ft., and has not been shown to regulate erythropoiesis under ordinary conditions. Erythropoietin may possibly be invoked only as an emergency erythropoietic stimulant in response to extreme hypoxic stress. This would be in accord with the observation that plasma erythropoietin is not detectable at sea level until hemoglobin concentration falls below 4 g/100 ml. On the other hand, it is possible that the capillary or tissue oxygen tension that is the primary stimu-

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