

Blood Studies on Dogs Subjected to Discontinuous Exposure to Low Oxygen Tension.

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Much of our knowledge of the effects of anoxic anoxia has been gained through studies of the experimental subject exposed continuously to low oxygen tensions, while relatively little has been obtained of the changes during discontinuous exposure. Since the latter condition prevails in aviation, at least up to the altitude above which oxygen is administered, and since it obviously presents different problems to the organism it is a worthwhile subject to study. Accordingly we have expanded our investigations of the changes occurring in the blood under this condition.

Methods. Five male dogs weighing 7.83 to 11.92 kg were the experimental animals. They were maintained on an adequate diet throughout the period of study, and the amount fed daily was adjusted to maintain their body weight practically constant. It has been our experience that during the period of exposure to anoxia the amount fed must be considerably increased to maintain the dogs in the same state of nutrition.

After a preliminary control period the dogs were exposed 8 hours daily (except Sundays) by means of a low pressure chamber to a partial pressure of oxygen of 80 mm Hg (18,000 ft) for a period of 88 days. Blood studies were made at weekly intervals. Blood specific gravity was determined on freshly drawn samples of venous blood by the falling drop method of Barbour and Hamilton.¹ Hemoglobin was determined by the Sahli method, and red blood cells were counted in the improved Neubauer counting chamber. At monthly intervals plasma protein was determined on 3 of the dogs by a modification of the method of Guillaumin, Wohl, and Lau-

rencin.² The control and the final values for plasma protein for each dog were determined on 4 separate blood samples drawn over the course of a week, while those for the first and second months were determined on 2 separate samples. Red blood cell fragility tests were made in duplicate at the conclusion of the experimental period.

Results and Discussion. The fragility of the red blood cells was normal; hemolysis began at 0.46 and was complete at 0.33% NaCl. This finding is at variance with those of Hurtado³ on native Peruvian Indians who live at high altitudes, and of Minot and Buckman⁴ in polycythemia vera. An increased resistance to hypotonic NaCl was found by these workers.

In Fig. 1 the mean percent changes in the number of red blood cells, hemoglobin values and plasma protein are plotted against time from the beginning of the period of discontinuous anoxia. The mean specific gravity values are plotted directly, with the control value set at the zero point of the ordinates for percent change, and the scale for specific gravity arbitrarily chosen to make the curve fall approximately with the hemoglobin curve.

The production of hemoglobin and the increase in number of red blood cells were practically parallel until the end of the fourth week of exposure to discontinuous anoxia. From then on hemoglobin production failed to keep pace with the red blood cell increase, and at the end of the period of anoxia, the hemoglobin value had increased 53% while red blood cells had increased 67%. However, the curves (not reproduced here) for the individual dogs show this characteristic in a definite way in but 2 out of the 5 cases. In

¹ Barbour, H. G., and Hamilton, W. F., *J. Biol. Chem.*, 1926, **69**, 625.

² Guillaumin, C. O., Wohl, R., and Laurencin, M. L., *Bull. soc. chim. biol.*, 1929, **11**, 387.

³ Hurtado, A., *Am. J. Physiol.*, 1932, **100**, 487.

⁴ Minot, F. R., and Buckman, T. E., *Am. J. Med. Sci.*, 1923, **166**, 469.

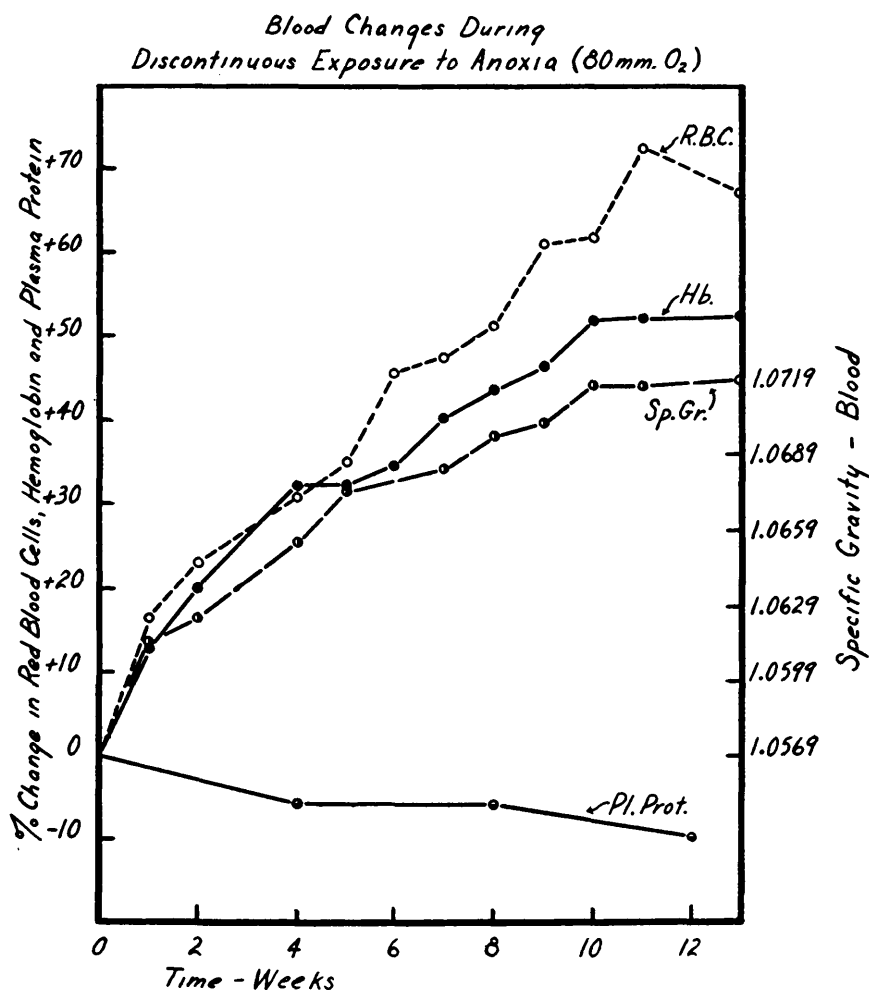


FIG. 1.

3 of the dogs a rough parallelism extended throughout the experimental period.

The concentration of plasma protein decreased slightly over the experimental period and at the end of the third month had decreased to approximately 10% below the control level. Statistical analysis of the data proved this to be insignificant for the group of 3 dogs. However, in the case of one dog, analyses of the series of determinations done each month showed a significant decrease throughout.

The average value for specific gravity increased from 1.0569 to 1.0719 during the period of discontinuous anoxia. A compari-

son of the curve for specific gravity with that for hemoglobin suggests that the former fails to reflect all the changes in the latter. It seems probable that the decrease in plasma protein (although but 3 of the 5 dogs are represented) would account for much of this divergence.

Summary. Five dogs exposed 8 hrs daily to an O₂ tension of 80 mm Hg (18,000 ft) for 88 days showed no change in red blood cell fragility. Hemoglobin values increased 53%, while the number of red blood cells increased 67%. The specific gravity of the blood rose from 1.0569 to 1.0719. Plasma protein concentration decreased 9.69%.