

and congenital malformations. Of the 92 developed fetuses produced by those rats receiving the delayed supplements, only 4—or less than 5% of the total—showed any gross abnormalities. This finding contrasts sharply with earlier reports of others, wherein almost half of the surviving fetuses were found to be defective. The reasons for these differences are not clear. The reproductive performance of rats raised and bred on a diet containing 2 mg of tocopherol per 100 of diet was normal, but when the tocopherol level was lowered to 1 mg or 0.5 mg the incidence of fetal abnormalities became 4 and 5%, respectively,

of the developed young. No differences were observed between the two rat strains.

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Received May 12, 1965. P.S.E.B.M., 1965, v119.

Blood Gas Transport in Chinchillas.* (30379)

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The family of rodents known as the chinchillidae have only a few species extant. These are known as the viscachas and chinchillas and they occur naturally in the mountains of South America. According to Walker (1) there are only 4 species of viscachas and a single species of chinchillas (*Chinchilla laniger brevicaudata*). Chiodi (2) has reported experiments with this species. We have studied 2 species of chinchillidae (3). Two viscachas were caught in their natural habitat in Northern Chile at an altitude of 15,000 feet. Blood studies on these specimens were not very complete because of field laboratory limitations. A colony of chinchillas (*Chinchilla laniger brevicaudata*) has been maintained in our laboratory at Duke University where these animals have thrived in good condition. Several have been used in numerous respiratory studies with uniform results. While chinchillas have a superficial resemblance to hares and rabbits (Lagomorpha), they are true rodents (Rodentia).

Studies were made of the respiratory function of 8 male chinchillas. These involved measurements of oxygen capacity, hemoglo-

bin concentration, hematocrit for relative volume of erythrocytes, number of erythrocytes per cubic millimeter, the position of the oxygen-dissociation curve, effect of changes in pH on the oxygen dissociation curve (Bohr effect) and the effect of oxygenation of blood on the carbon dioxide dissociation curve (Haldane effect).

Methods. Blood samples were drawn into disposable plastic syringes by direct cardiac puncture. About 8-10 ml of arterial blood was obtained. Animals were tranquilized by an intraperitoneal injection of a small amount of Nembutal. Minimal amounts of Heparin (Organon) were used as an anticoagulant. Blood samples were kept cold until used for tonometric equilibration. All analyses were completed in approximately 2 hours from time of blood withdrawal. Analytical methods and equilibration procedures have been described fully in a previous study of mammalian blood (4). They are not repeated here because identically similar methods and procedures were followed in the present studies.

Results of studies of chinchilla blood are shown in Fig. 1 and Table I. Fig. 1 shows the position of the oxygen dissociation curves of whole blood at 37°C. No attempt was

* Supported by National Science Foundation Grant GB-349.

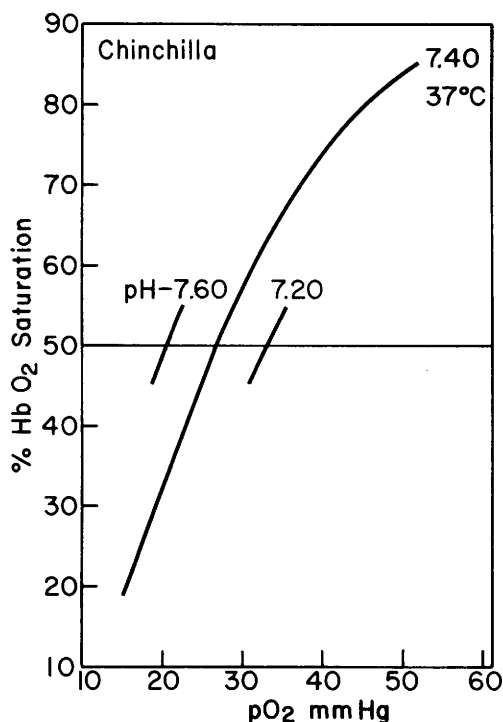


FIG. 1. Oxygen dissociation curve of chinchilla blood at pH 7.40 and 37°C and positions of the oxygen dissociation curves at 50% saturation at pH 7.20 and pH 7.60 and 37°C.

made to determine oxygen saturation values above 85% or below 15% at pH 7.4 and only a few points on either side of the 50% saturation line at pH 7.2 and pH 7.6 to establish the Bohr effect. Variations in pH of blood were obtained by equilibrating blood with gas mixtures containing various concentrations of carbon dioxide and oxygen. Five duplicate analyses were made on the blood of each of 8 individual chinchillas to estab-

TABLE I. Respiratory Properties of the Blood of 8 Male Chinchillas Ranging in Body Weight from 382 g to 613 g.

Hematocrit (% erythrocytes)	37.4 ± 4.9
Hemoglobin (g/100 ml)	11.6 ± 1.3
Erythrocytes ($\times 10^6/\text{m}^3$)	6.90 ± .71
T_{50} (pO_2 mm Hg where $\text{Hb} = \text{HbO}_2$)	26.8 ± .3
at pH 7.40, 37°C	
Bohr effect, 37°C, ($\log \Delta \text{pO}_2$ at $T_{50}/\Delta \text{pH}$)	.534 ± .01
Standard bicarbonate, pCO_2 of 40 mm Hg, 37°C	
mM/l (blood fully reduced)	21.47
mM/l (blood fully oxygenated)	18.82
mM/l (Haldane effect)	2.65

lish the position of the oxygen dissociation curve at pH 7.4, and 37°C and 2 duplicate analyses of blood were equilibrated at pH 7.2 and at pH 7.6. The average curves shown in Fig. 1 were constructed from the average values obtained from blood of each of 8 chinchillas with a total of 72 duplicate analyses. The span in pO_2 , at the 50% saturation line, between the curves of any 2 individual blood samples was less than 1 mm Hg. Table I gives average values obtained for various blood constituents and characteristics with the standard deviation from mean values. The Haldane effect was determined by analyses of whole blood samples equilibrated with gas mixtures to fully reduce or fully oxygenate them at a pCO_2 40 mm Hg. The difference in the standard bicarbonate values represents the Haldane effect.

Discussion. It is interesting to note that the position of the oxygen dissociation curve of chinchilla blood at pH 7.4 almost exactly coincides with the oxygen dissociation curve of human blood. This suggests a specialized type of oxygen-hemoglobin affinity in the chinchilla, because in many animals the position of the curve is influenced by body size. Schmidt-Nielsen and Larimer(5) have shown that the oxygen dissociation curve is related to body size in such a way that the blood of smaller mammals has a higher unloading tension for oxygen. Chinchillas appear to be an exception to that principle. The Bohr effect which was determined on whole blood, also closely approximates that of human blood and the position of the oxygen dissociation curves at pH 7.2 and pH 7.6 is close to those of human blood. The significance of the Bohr effect has been discussed by Hilpert *et al*(6). The Haldane effect does not vary much from that of other mammals that have been studied in this regard. The standard bicarbonate values are a little lower than those given for average human or dog blood.

Chinchillas can extract oxygen from their immediate environment to a comparatively low partial pressure. Studies in our laboratory have indicated that in an environmental temperature of 25°C they can extract and utilize oxygen as low as 20 mm Hg partial pressure before death ensues. Compared with

many mammals this is a low value and indicates the ability of chinchillas to survive at high altitudes or in other hypoxic surroundings. Some animals appear to be limited to narrow ranges of environmental oxygen tensions, while others survive and successfully adjust to wider ranges. Chinchillas are in the latter group.

One cannot say whether animals have acquired these characteristics as a consequence of residence for hundreds of generations at high altitude or whether they found high altitude tolerable and advantageous because of these characteristics. It seems plausible to suppose that natural selection has been operating to the end that animals may acquire blood with an optimal position of the oxygen dissociation curve, one that yields an adequate supply of oxygen to the tissues under the limitations imposed by their external environment.

Summary. The respiratory functions of the blood of chinchillas (*Chinchilla laniger*) has

been studied. Measurements of hematocrit, number of erythrocytes, and hemoglobin concentration have been made. The position of the oxygen dissociation curve has been established. This is to the left of most other rodents of similar size indicating an adaptation to high altitudes. The Bohr effect and the Haldane effect are similar to other closely related mammals.

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Received May 5, 1965. P.S.E.B.M., 1965, v119.

Reverse Passive Cutaneous Anaphylaxis with Guinea Pig 7S Antibodies.* (30380)

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Guinea pigs can be sensitized for reverse passive cutaneous anaphylaxis (RPCA) reactions with rabbit or human gamma globulins (1,2,3).

The challenging antibody can be from any species, including those which do not sensitize guinea pigs for direct anaphylactic reactions, provided that the antigen is able to sensitize (to "fix" to guinea pig tissues).

Recently, it was shown that guinea pigs can produce 2 types of 7S antibodies(4,5,6); a faster moving gamma 1 capable of sensitizing guinea pigs for PCA reactions but unable to fix complement *in vitro*, and a slower moving gamma 2 antibody unable to sensitize

guinea pigs for anaphylactic reactions but capable of fixing complement.

It seemed of interest to investigate these two 7S antibodies from the same species in RPCA reactions. Antibodies specific for the 2,4-dinitrophenyl determinant (DNP) were used for these experiments.

Materials and methods. *Passive cutaneous anaphylaxis (PCA) and reverse passive cutaneous anaphylaxis (RPCA).* PCA and RPCA were carried out as previously described(7).

Passive lysis. Passive lysis was carried out as described in(6). In brief, sheep erythrocytes were tanned(8) and coated with DNP-bovine serum albumin (DNP-BSA). Antibody preparations were diluted in veronal buffer according to(9). Lyophilized guinea pig complement (Certified Blood Donor Serv-

* Supported by Nat. Inst. Health, Grant AI-03075-06 and Health Research Council, City of New York, Contract I-140.

† Health Research Council Career Scientist.