Correspondence

The Oxygen-combining Capacity of Hemoglobin

To the Editor—Both the excellent contribution of Dr. Theye (ANESTHESIOLOGY 33: 653, 1970) and the interesting discussion by Dr. Pryss-Roberts and associates (ANESTHESIOLOGY 34:581, 1971) point to the uncertainties in our understanding of the "physiologic" value of the O_2-combining capacity of hemoglobin. According to the experiments of both investigators, the latest "theoretical" value, 1.39, seems to overestimate considerably the real O_2-combining capacity, and even Hüfner's factor of 1.34 appears to be a maximal value. The authors caution, with good reason that we cannot rely on derived estimates of blood oxygen content based on measurements of P_0_2, P_C0_2, pH, HbO_2 and hemoglobin concentration of the same blood. However, since our experimental data disagree with the results of Dr. Theye and those of Dr. Pryss-Roberts et al., we would like to call attention to our findings, which have been described in a recent article.

In 88 nonsmokers breathing pure oxygen we measured the O_2 content of arterial blood with the van Slyke apparatus (determination of blood O_2-carrying capacity in vivo). In the same blood samples, in parallel, we determined P_0_2 using an IL-Platin electrode (in all cases P_0_2 exceeded 300 mm Hg); Hb, with an IL-CO-Oximeter (calibrated regularly by the cyanmethemoglobin method); and CO-saturation. Subtraction of physically dissolved O_2 from blood O_2 content gave the O_2-carrying capacity of the blood. The division of this value by the factor 1.39 yielded a content of active hemoglobin which was, on an average, 0.35 (±0.35) g/100 ml lower than the content of total hemoglobin as determined by the IL-CO-Oximeter (P < 0.001). The mean CO-saturation of the samples was 1 per cent, corresponding to 0.15 g/100 ml HbCO. The remaining 0.20 g/100 ml hemoglobin is probably inactive also; this interpretation seems justified since it has been shown that the methemoglobin content in blood of normal subjects is of the same order of magnitude.

Hence, our results give good evidence that 1.39 is not only a theoretical but a very physiologic value for the O_2-combining factor. We cannot offer a sound explanation for the discrepancy between our data and those of Dr. Theye and Dr. Pryss-Roberts et al. On one hand, it may be that in their calculations these investigators did not make sufficient allowance for the carboxyhemoglobin of blood. On the other hand, different methods were applied; it may be that during in-vitro determinations of blood oxygen-carrying capacity using a tonometer—in contrast to the in-vitro saturation technique applied in our experiments—the O_2-combining capacity of hemoglobin is less, for reasons yet unknown, or rather, the ratio of inactive to active hemoglobin is greater.

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