The Oxyhemoglobin Dissociation Curve during Acetate and Bicarbonate Dialysis

Intradialytic Changes in the Oxyhemoglobin Curve

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Dear Sir,

Adequate oxygen tissue uptake, apart from the total amount of oxygen carried to the tissues, finally depends upon effective oxygen delivery from the intraerythrocyte-oxyhemoglobin complex. Decreases or increases in blood CO₂ which could result in a shift either way in the oxyhemoglobin dissociation curve (ODC) [3], might play a critical role in blood-to-tissue oxygen transfer. As CO₂ dissolved in the bicarbonate dialysis (BD) bath is said to obviate the hypocapnic effect of traditional acetate dialysis (AD) [1], one could infer that the more favorable effect of BD with respect to AD [2] might be due to better oxygenation of the peripheral tissues. To settle this point, we studied the intradialytic ODC changes in 7 uremics submitted to a single

28 27 26 25

7.50 7.45 7.40 7.35 I 7.30 42

40

38 36 34

100 -

90

240

0 60 120

Dialysis duration, min

Fig. 1. Effects of dialysis with bicarbonate (•) and acetate (o) on arterial p50, pH, PCO₂ and PO₂ in 7 dialyzed patients. Mean $\pm$ SE are indicated. †, * = Significance (at least p 0.05) within groups in respect to the time 0 min or between groups at the same time, respectively.

AD and, a week later, to a BD or vice versa. The ODC was assessed by determining the p50, i.e. the PO₂ at which hemoglobin is half-saturated with oxygen at pH 7.4. The blood samples were drawn from the arterial blood of the A-V fistula and measurements were made on the whole blood using an automated apparatus (co-oxymeter 2282IL, tonometer 237 IL). As depicted in figure 1, BD induced a significant increase in p50, denoting a decrease in hemoglobin affinity for

oxygen, while AD resulted in only a slight, insignificant and short-lasting p50 increment. PCO₂ tended to increase during BD but declined markedly during AD. PO₂ shared a mild insignificant decrease in both cases. We think the present findings could be of relevance for understanding the better intradialytic tolerance to BD with respect to AD. During AD, the acetate load, the heparin-induced increase in NEFA plasma concentration, and the glucose added to the dialysis bath may all induce an increase in the rate of oxydative cellular metabolism. This would result in raised oxygen tissue demands, thereby requiring an increase in both cardiac and respiratory activity. Decreased hemoglobin affinity for oxygen, in the manner in which it occurs during BD, can be expected to be of benefit because it would permit a greater oxygen delivery to the tissues without increasing the oxygen demands of the other components of the oxygen supply system.

References

Dolan, M.J.; Whipp, B.J.; Davidson, W.D.; Weitzman, R.E.; Wasserman, K.: Hypopnea associated with acetate hemodialysis. Carbon-dioxide-flow-dependent ventilation. *New Engl. J. Med.* 305: 72 (1981).

G. Graefe

U.; Milutinovich

J.; Follette

W. C.; Babb

A. L.; Scribner

B.H.: Less dialysis-induced morbidity and vascular instability with bicarbonate in dialysate.

Ann. intern. Med. 88: 332 (1978).

Wranne

B.; Woodson

R.D.; Detter

J.C.: Bohr effect. Interaction between H⁺

CO₂ and 2,3-DPG in fresh and stored blood. *J. appl. Physiol.* 32: 749 (1972).