Letters to the Editor

Does Normovolemic Hemodilution Decrease Myocardial Oxygen Consumption Despite Increased Heart Work?

To the Editor:

In acute normovolemic hemodilution studies, Habler et al. (1) have reported a 5% increase in total O_2 consumption at a hemoglobin content (cHb) of 6.9 g/dL in relation to baseline conditions (cHb 12.6 g/dL), which is in good agreement with the published data indicating a constant O_2 consumption down to a cHb of 4–5 g/dL (2 review of seven sources). The same is valid for the increase in cardiac output of 45%–70% (3–6), i.e., 33%. However, in contrast to the literature, Habler et al. (1) also report that the "myocardial oxygen consumption is not affected by hemodilution despite the fact that right and left ventricular stroke work increased significantly."

Other data based on comparable steps in hemodilution, not cited by the above-mentioned authors, are summarized in Table 1. Habler et al. (1) would have demonstrated a significant decrease in myocardial O_2 consumption by 12%, while others have measured a constant (4) or an increased O_2 consumption of 8%–37% (3,5,7).

Originally, the authors had published a decrease of 8% (not significant), which changed to a value of 12% if the so called Hüfner number or oxygen capacity of 1.39 mL/g (8,9) instead of 1.34 mL/g was used. This increased the O_2 content (e.g., arterial O_2 from 15.8 to 16.6 mL/dL) and the arteriovenous O_2 difference and, therefore, the myocardial O_2 consumption to 9.6 $mL \cdot min^{-1} \cdot 100\ g^{-1}$ (9.1) and to 8.5 (8.4) after hemodilution. In fact, this is the very first time that "work output increases while energy input decreases."

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Table 1. Data (Dogs) of Cardiac Output (CO) or Cardiac Index (CI) and Corresponding Data for Coronary Perfusion ($\dot{Q}$) As Well As Myocardial Oxygen Consumption ($\dot{Q}O_2$) During Normovolemic Hemodilution for Comparable Hemoglobin Concentration (cHb) Changes

Change in	v. Restorff et al. (6,7)	Kettler et al. (5)	Jan et al. (4)[a]	Crystal et al. (3)	Habler et al. (1)
cHb (g/dL)	15.8/7.5	14.8/6.4	14.3/8.2	14.8/8.1	12.6/6.9
CO ($mL \cdot min^{-1} \cdot kg^{-1}$)	104/165	140/234	112/189		
CO (L/min)				1.74/2.54	
CI ($L \cdot min^{-1} \cdot m^{-2}$)					3.6/4.8
ΔCO or CI (%)	+59	+67	+69	+46	+33
$\dot{Q}$ ($mL \cdot min^{-1} \cdot 100\ g^{-1}$)	41/98	63/230	55/91	63/124	103/176
$\dot{Q}O_2$ ($mL \cdot min^{-1} \cdot 100\ g^{-1}$)	6.5/8.9	8.5/11.0	8.2/8.1	7.8/8.4	9.6/8.5[b]
$\Delta\dot{Q}O_2$ (%)	+37	+29	−1	+8	−12[b]

[a] Data taken from Table 1 and Figures 2 and 4 from this reference.
[b] Correct calculation of oxygen content with 1.39 mL O_2 per gram of hemoglobin also used in all other literature sources.