

O<sub>2</sub> Extraction of Right and Left Ventricles (39325)

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(Introduced by E. F. Adolph)

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Simultaneous measurements of O<sub>2</sub> extraction, and hence  $\dot{V}O_2$  are not available in the literature for the right ventricle working *in situ*. This information is essential for computations of tissue  $pO_2$  gradients in right ventricle, and for comparison of the function of the two ventricles.

**Materials and methods.** Mongrel dogs were anesthetized with Na pentobarbital, 60 mg/kg body weight. They were ventilated at a rate which maintained PaCO<sub>2</sub> and pHa within normal limits. Because of large  $\dot{V}A/Q$  inequalities during cardiac manipulation in open-chest dogs, it was necessary to use 100% O<sub>2</sub> as the inspired gas to insure full saturation of hemoglobin. From 250-500 ml of dextran were given to compensate for blood loss and the hemodynamic effects of thoracotomy. The right ventricular free wall was exposed, and a catheter was inserted into the coronary sinus via the right jugular vein. The catheter tip was positioned to sample blood from the posterior aspect of the left ventricle. The free wall of the right ventricle is drained by several small anterior cardiac veins (1). One of these was punctured with a #24 needle attached to a flexible polyvinyl catheter. Care was taken to insure that the vein selected was well removed from the interventricular septum. Blood was drawn simultaneously from the two venous catheters into oiled glass syringes which contained dry heparin. Care was taken to discard blood which had been in contact with air or saline in the dead space of the catheters. An arterial sample was also drawn simultaneously, or immediately after venous samples were collected. Hemoglobin percentage saturation and blood gases were measured with an Instrumentation Laboratories system; the co-oximeter was calibrated for dog blood. Arterial pressure was monitored on an oscillo-

scope. It remained stable and within normal limits throughout.

**Results and discussion.** Table I summarizes results of 11 measurements in four dogs. Replicates for each dog were averaged, and these average values used to calculate means and standard errors. Extraction was about 2.5 vol% higher in blood from left ventricle. Note that the difference in extractions is about the same over a 2.5-fold range of arterial O<sub>2</sub> content. On the other hand,  $pO_2$  was about 6 mm Hg higher in blood draining right ventricle.

In man (2) and dog (1, 3) blood flow/100 g in right ventricle is about 60% that of the left. Combining this figure with the ratio of O<sub>2</sub> extraction in right and left ventricles from Table I:

$$\dot{V}O_2/100 \text{ g RV} \approx 0.6 Q/100 \text{ g LV} \times [0.75 (\text{CaO}_2 - \text{CvO}_{2\text{LV}})].$$

Thus, in large animals  $\dot{V}O_2/100 \text{ g}$  of right ventricle is 40-50% of the  $\dot{V}O_2/100 \text{ g}$  of left ventricle. Since end-capillary  $pO_2$  is higher in right ventricle, and right ventricular  $\dot{V}O_2$  is lower, one would expect intracellular  $pO_2$  to be higher in right ventricle. However, according to Whalen and co-workers (4), intracellular  $pO_2$  is the same in the two ventricles. This can only be true if diffusion distances are larger in right ventricle than left. This appears to be the case (5).

To our knowledge the only studies of O<sub>2</sub> extraction of right ventricle previous to ours have been made during cardiac by-pass (1, 6). They therefore do not pertain to the working right ventricle. Moreover, measurements on by-pass are subject to criticism on technical grounds for right ventricular venous drainage was collected from the right ventricular cavity (1, 6). Since arterial as well as venous connections with the lu-

TABLE I. O<sub>2</sub> EXTRACTION BY RIGHT AND LEFT VENTRICLES.

Dog number	Sample number	Arterial blood			Anterior cardiac vein			Coronary sinus			Average differences		
		Hb (g%)	PaO <sub>2</sub> (mm Hg)	CaO <sub>2</sub> (Vol%)	pH <sub>a</sub>	P <sub>RV</sub> O <sub>2</sub> (mm Hg)	C <sub>RV</sub> O <sub>2</sub> (Vol %)	Extraction (Vol%)	P <sub>LV</sub> O <sub>2</sub> (mm Hg)	C <sub>LV</sub> O <sub>2</sub> (Vol %)	Extraction (Vol%)	RV-LV P <sub>O</sub> <sub>2</sub> (mm Hg)	LV-RV extraction (Vol%)
1	1	7.2		10.63	7.47	31.3	—	—	22.7	3.16	7.47	9.30	2.62
	2					34.5	5.97	4.66	23.7	3.25	7.38		
	3		488			31.2	5.78	4.85	22.7	3.25	7.38		
2	1	12.3		16.84	7.44	26.3	7.83	9.01	19.6	5.17	11.67	5.17	2.32
	2		450			26.1	—	—	20.6	5.17	11.67		
	3					24.1	6.99	9.85	20.8	5.0	11.84		
3	1	14.3	130	18.98	7.31	37.0	11.42	7.56	30.2	8.52	10.46	6.87	2.96
	2	14.2	123	18.96	7.32	37.5	11.22	7.74	30.0	8.52	10.44		
	3	14.4	127	18.81	7.33	36.5	11.61	7.20	30.2	8.33	10.48		
4	1	19.9	313	27.34	7.38	41.5	19.51	7.83	34.3	15.18	12.16	3.60	2.16
	2	20.2	292	27.01	7.37	33.4	14.91	12.10	33.3	14.91	12.10		
Mean		13.5	340	18.40	7.40	33.07	10.48	7.92	26.82	7.31	10.52	6.25	2.52
± SE												1.22	0.18
												P < 0.05	P < 0.001

men exist (1), the O<sub>2</sub> content of blood from the lumen may be erroneously high. Measurements during by-pass are widely used to estimate the O<sub>2</sub> cost of resting metabolism, excitation, and internal work. We therefore urge that right ventricular O<sub>2</sub> extraction during by-pass be reinvestigated by the venipuncture method used in the present study.

**Summary.** O<sub>2</sub> extraction was measured simultaneously in right and left ventricles of dogs. Extraction was about 2.5 vol% higher in left ventricle. This figure, together with flow measurements of others (1-3), indicates that  $\dot{V}O_2/100$  g is at least twice as great in left ventricle as in right.

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