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Title: THE EFFECT OF ISOPROTERENOL ON CARDIAC OUTPUT AND REGIONAL ORGAN BLOOD FLOW IN PRETERM NEWBORN LAMBS

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Introduction. Isoproterenol has been used clinically to augment cardiac output in premature and term infants with a variety of cardiopulmonary disorders including Hyaline Membrane Disease and sepsis. Although isoproterenol is presumed to increase cardiac output by increasing heart rate and myocardial contractility while decreasing systemic vascular resistance, this has not been confirmed in the premature infant. In addition, the effect of isoproterenol on regional organ blood flow has not been studied.

Methods. We studied the effectof an isoproterenol infusion on cardiac output and regional organ blood flow in preterm newborn lambs by the radionuclide labelled microsphere technique. We delivered 5 preterm lambs by cesarean section under epidural anesthesia at 0.85 gestation (125 days). The lambs were intubated and ventilated mechanically at a respiratory rate sufficient to maintain a $PaCO_2 < 40$ torr and at an F_iO_2 sufficient to maintain a carotid arterial $PaO_2 > 100$ torr. The animals were maintained normothermic by an infrared heat source. We placed catheters in the femoral (FA) and carotid (CA) arteries, the left ventricle (LV), superior (SVC) and inferior (IVC) cavale for microsphere injections and withdrawals and pressure recordings. Control measurements of heart rate, LV, FA, and SVC pressures were obtained. Cardiac output and regional organ blood flow were obtained by injection of radionuclide labelled microspheres in the SVC and LV. Isoproterenol was infused at an average dose of 0.5 ugm/kg/min in order to increase heart rate from a mean control of 160 bpm to 212 bpm. Repeat physiologic and flow measurements were made.

Results. Cardiac output increased from a mean control of 343.7 ± 28.4 ml/kg/min to 576.1 ± 79.5 ml/kg/min.

Physiologic pressures changed as follows:

Table I

Pressures (Torr)	Control	$\bar{p}$ Isoproterenol
Left ventricle	85.5±6.2	66.8±0.6
	5±2	4±1.6
Femoral artery	82.5±4.3	65.5±5.9
	56.3±4.2	41±5.3
Superior vena cava (mean)	5.3±.8	6.2±.7

Distribution of left ventricular blood flow changed as follows:

Table II

Organ	Blood flow in ml/mg of organ wt/min Control	Isuprel	Per cent of cardiac output Control	Isuprel
Rt kidney	2.4±0.5	4.9±1.7	2±0	3±.8
Lt kidney	2.4±0.5	4.1±1.3	2.2±.2	3.4±.9
Gut	0.8±0.1	0.9±0.3	11.5±.8	10.5±3.8
Liver	0.6±0.1	0.8±0.3	3.5±.8	4.0±1.2
Brain	1.8±0.3	1.7±0.3	4.8±.4	3.8±.4
Heart*	1.8±0.6	5.6±1.9	5.0±2.1	9.5±3.3
Carcass**	0.15±.01	.35±.04	30.3±2.4	54.5±5.3

*$p < 0.05$ **$p < 0.005$

Conclusions. Despite a 73 per cent mean increase in cardiac output, organ blood flow per gram of organ weight to the kidneys, splanchnic organs and brain remained unchanged whereas blood flow to the myocardium and carcass (skin, skeletal muscle, bone) increased. As a percent of cardiac output, blood flow to the carcass increased from 30 to 55 per cent and received the greatest increase in blood flow. These data do not support the concern that isoproterenol redistributes blood flow from the renal and splanchnic vascular beds to the skin and skeletal muscle, but rather, only the myocardium, skin and skeletal muscle receive an increase in blood flow due to an increase in cardiac output with isoproterenol.