

Title: THE CARDIOVASCULAR EFFECTS OF HALOTHANE DURING HYPOXEMIA IN NEWBORN LAMBS

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**Introduction.** Halothane is commonly used to anesthetize hypoxemic infants. However the cardiovascular and metabolic effects of halothane are unknown during hypoxemia. Therefore, we measured the O<sub>2</sub> consumption, cardiac output, and tissue O<sub>2</sub> delivery in normoxic and hypoxemic newborn lambs during 0.5 and 1 MAC halothane anesthesia.

**Methods.** Six term lambs, less than three days old, were studied in the supine position. They were initially anesthetized with N<sub>2</sub>O and local anesthesia. Catheters were inserted into the femoral, carotid and pulmonary arteries, the left ventricle and a peripheral vein. Then the lambs were paralyzed with pancuronium (0.1 mg/kg), intubated, and mechanically ventilated; N<sub>2</sub>O was discontinued. Heart rate and systemic and pulmonary blood pressures were recorded continuously. Lactic acid, O<sub>2</sub> consumption and cardiac output (determined with 15μ radioactive microspheres) were measured 15 minutes after the institution of the following conditions: 1) mechanical ventilation with room air, 2) mechanical ventilation during hypoxemia (PaO<sub>2</sub> = 30 torr), 3) room air and 0.5 MAC halothane, 4) hypoxemia (PaO<sub>2</sub> = 30 torr) and 0.5 MAC halothane, 5) room air and 1 MAC halothane, 6) hypoxemia (PaO<sub>2</sub> = 30 torr) and 1 MAC halothane. The sequence of 0.5 or 1 MAC halothane was alternated in successive experiments. The data were analyzed by analysis of variance.

**Results.** During normoxia, 0.5 and 1 MAC halothane reduced the O<sub>2</sub> consumption 25% and 45% respectively from normoxia without anesthesia (Table 1). During 0.5 MAC halothane cardiac output, blood flow/100gm of tissue and tissue O<sub>2</sub> delivery to most organs were unchanged except in the liver where the flow increased 300%. 1 MAC halothane reduced the cardiac output 47% and reduced the blood flow/100gm and tissue O<sub>2</sub> delivery in most organs except the liver where the flow increased 240%.

During hypoxemia with 0.5 and 1 MAC halothane, O<sub>2</sub> consumption was reduced an additional 39% and 51% respectively from hypoxemia without anesthesia (Table 2). During hypoxemia with and without anesthesia, blood flow/100 gms of tissue was increased to the brain, heart and liver which maintained the tissue O<sub>2</sub> delivery at the immediately previous normoxic values. Both mean pulmonary arterial pressures and serum lactic acids were elevated but similar during hypoxemia with or without

anesthesia.

Hypoxemia reduced O<sub>2</sub> consumption 25-30% from the immediately previous normoxic value. However, cardiac output was unchanged from the previous normoxic value with or without anesthesia.

**Discussion.** Halothane causes larger reductions in total body O<sub>2</sub> consumption in neonates than in adults (1). Although 1 MAC halothane reduces cardiac output and regional blood flow, it does not interfere with the redistribution of blood to the heart and brain during hypoxemia. In addition, halothane does not attenuate hypoxic pulmonary vasoconstriction in lambs. Despite reducing cardiac output and blood pressure, 1 MAC halothane does not appear to be detrimental during hypoxemia.

**Reference.**

1. Theye R: Anesthesiology 37:367, 1972

Table 1. Room Air and Mechanical Ventilation

	No. Anesth.	0.5 MAC	1.0 MAC
VO <sub>2</sub> (ml/kg)	14.3±5	10.8±9*	8.2±1.0*
Lactic acid (mg %)	24±5.0	42±9*	43±7*
Mean BP (mm Hg)	92±4.0	79±5.4	65±4.1*
Mean PA (mm Hg)	23±1.7	32±4.1	21±1.3
CO (ml/kg)	390±10.1	328±28	210±22*
Blood flow/100 g:			
Brain	83±10	69±4	64±7
Heart	332±90	279±23	138±19*
Liver	15±3	57±25*	49±10*
Kidney	292±21	309±33	227±6*
Gut	122±15	124±16	65±8*
O <sub>2</sub> del. (ml/min):			
Brain	3.4±1	2.8±.4	2.1±1*
Heart	5.6±1.3	3.9±.3	2.5±.4
Liver	1.9±.3	5.7±2*	5.1±.7*
Kidney	38±7	28±5	18±5*
Gut	10±1	9±1.3	6.4±.9*

Values are mean ± SEM. \*P < 0.05

Table 2. Hypoxemia and Mechanical Ventilation

	No. Anesth.	0.5 MAC	1.0 MAC
VO <sub>2</sub> (ml/kg)	9.7±.6	6.9±.5*	4.8±.2*
Lactic acid (mg %)	41±6	46±13	49±12
Mean BP (mm Hg)	93±4	69±4*	55±4*
Mean PA (mm Hg)	44±5	47±4.6	38±6.0
CO (ml/kg)	359±49	321±28	210±38*
Blood flow/100 g:			
Brain	142±13	123±10	94±13*
Heart	767±184	582±65	304±97*
Liver	63±21	59±10	37±8*
Kidney	281±42	275±19	164±34*
Gut	108±19	94±18	72±17*
O <sub>2</sub> del. (ml/min):			
Brain	2.0±.1	1.6±.2	1.8±.2
Heart	7.1±1.5	5.1±.4	2.7±.7*
Liver	2.7±.8	2.8±.4	1.8±.3
Kidney	.5±.1	.8±.3	.7±.1
Gut	3.2±.4	3.3±.3	2.0±.4*

Values are mean ± SEM. \*P < 0.05