Title: ISOFLURANE VERSUS SUFENTANIL: EFFECTS ON EXPERIMENTAL MYOCARDIAL INFARCTION

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Introduction. Few data exist that assist in the choice between a narcotic and an inhalational agent for anesthesia for patients with ischemic heart disease. Isoflurane for such patients may be inappropriate because it may redistribute regional myocardial blood flow (RMBF) away from collateral dependent zones. Conversely, high doses of narcotics may not suppress adverse hemodynamic effects of surgical stimulation. We compared, in the same protocol, the effects of isoflurane and sufentanil on experimental outcome in a canine model of myocardial infarction.

Materials and Methods. Thirty-six adult mongrel dogs were anesthetized (thiamylal, 16 mg/kg IV plus 8 mg/kg/h), intubated orotracheally, and ventilated mechanically. Institutional guidelines for laboratory animal research were followed. Surgical preparation included a left thoracotomy, placement of a left anterior descending coronary artery (LAD) ligature, and cannulation of the left ventricle (LV, Millar catheter), the left atrium for microsphere injection, the aorta for pressure and microsphere reference blood sampling, and the pulmonary artery for measurement of pressure and cardiac output by thermodilution. The dogs received either sufentanil, 10 μg/kg bolus plus an infusion of 0.1 μg/kg/min (n = 15); isoflurane 1.3% inspired (n = 10); or continued thiamylal infusion, 4 mg/kg/h, plus intercostal nerve block (0.5 ml 10% formalin) to provide additional analgesia (control group, n = 11); sufentanil or isoflurane was begun 15-30 min before LAD occlusion. Lidocaine, 1 mg/kg IV, was given to all dogs 2 min before LAD occlusion was produced by tightening the ligature. Hemodynamic variables were recorded and microspheres injected for RMBF calculation before LAD occlusion and 1, 3, 6, and 12 h after LAD occlusion, after which hearts were removed to measure myocardial infarct size and RMBF.[1] Data were subjected to multivariate repeated measures analysis of variance (post hoc testing with Duncan's multiple range test), Student's t test for grouped data (infarct size), and with chi-square and Fisher's exact tests (mortality and ventricular fibrillation frequency).

Results. Of the 36 dogs, 26 survived the 12-h infarction (table 1). Myocardial infarct size was 30.40% of LV with isoflurane and 32.43% with sufentanil, both significantly different from the 39.95% with thiamylal ($P < 0.05$). Hemodynamic effects in the 3 groups differed significantly (table 2).

Discussion. The results imply that the more complete anesthetic state produced by either isoflurane or sufentanil (intense analgesia in addition to unconsciousness) compared with that produced by thiamylal decreases the extent of myocardial infarction. The mechanism is not established by these data since infarct size was smaller despite a lower infarct RMBF with isoflurane or sufentanil. The difference in ventricular fibrillation frequency between isoflurane and sufentanil is striking, but a distinction between an arrhythmogenic effect (sufentanil) and an antiarrhythmic effect (isoflurane) is not possible from the data.

Reference

1. Davis RF, DeBoer LWV, Rude RE, Lowenstein E, Maroko PR: The effect of halothane anesthesia on myocardial necrosis, hemodynamic performance, and regional myocardial blood flow in dogs after coronary artery occlusion. ANESTHESIOLOGY 59:402-411, 1983

TABLE 1. Deaths and Frequency of Ventricular Fibrillation

	Control	Isoflurane	Sufentanil
Survival* (n)			
Yes	9	9	8
No	2	1	7
Fibrillation† (n)			
Yes	4	1	10
No	7	9	5

*Overall chi-square, P = 0.0917; Fisher's exact test, P = 0.0515 for isoflurane vs. sufentanil.

†Overall chi-square, P = 0.0174; Fisher's exact test, $P < 0.001$ for isoflurane vs. sufentanil.

TABLE 2. Effects of Isoflurane (I), Sufentanil (S), or Thiamylal (Controls, C) on Hemodynamic and Regional Myocardial Blood Flow (RMBF) During Left Anterior Descending (LAD) Coronary Artery Occlusion

	Time After LAD Coronary Artery Occlusion (h)				
Agent	0	1	3	6	12
	Normal Myocardial Transmural RMBF (ml/min/100 g)				
C	117 ± 14	158 ± 17	155 ± 19	174 ± 27	153 ± 18
I	77 ± 6*	117 ± 14	100 ± 16*	99 ± 13*	88 ± 16*
S	91 ± 15*	118 ± 22	70 ± 9*	90 ± 14*	79 ± 11*
	Infarcted Myocardial Transmural RMBF (ml/min/100 g)				
C	105 ± 16	22.1 ± 5.2	20.0 ± 3.8	14.7 ± 3.5	11.0 ± 2.9
I	69 ± 8	7.3 ± 1.4*	8.3 ± 2.0*	7.2 ± 1.3*	6.8 ± 1.7
S	76 ± 11	6.4 ± 1.5*	5.5 ± 1.6*	5.3 ± 1.1*	3.7 ± 1.5*
	Left Ventricular Mean Systolic Pressure (mmHg)				
C	153 ± 6	145 ± 7	137 ± 7	123 ± 10	89 ± 5
I	99 ± 8*	92 ± 9*	96 ± 8*	89 ± 5*	71 ± 5
S	106 ± 11*	108 ± 7*	115 ± 4*†	100 ± 5*	83 ± 5
	Left Ventricular End Diastolic Pressure (mmHg)				
C	10 ± 2	12 ± 2	12 ± 2	12 ± 2	11 ± 2
I	5 ± 1*	7 ± 1	6 ± 1*	5 ± 1*	3 ± 1*
S	5 ± 2*	8 ± 2	9 ± 2	8 ± 2	8 ± 2
	Heart Rate (beats/min)				
C	157 ± 12	166 ± 10	168 ± 11	173 ± 9	159 ± 7
I	120 ± 6*	124 ± 5*	132 ± 7*	140 ± 7	140 ± 6
S	141 ± 11	132 ± 15*	137 ± 10*	149 ± 17	153 ± 11

*$P < 0.05$ vs. corresponding control value.

†$P < 0.05$ vs. corresponding value with isoflurane.