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 Title : TRANSMURAL CORONARY BLOOD FLOWS AND MYOCARDIAL METABOLISM WITH HIGH DOSE FENTANYL
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Introduction. High dose fentanyl for induction of anesthesia (50 to 75 µg/kg) in patients undergoing cardiac surgery is gaining widespread acceptance. There is, however, little data regarding potential changes in regional myocardial blood flows or left ventricular (LV) metabolic rates with this technique. In this study, the hemodynamic effects, regional myocardial blood flows and LV metabolic rate following the administration of 50 µg/kg of fentanyl in dogs were investigated.

Methods. Eleven mongrel dogs were included in the study. Hemodynamic parameters measured under control conditions (1.25% enflurane) include heart rate (HR), mean arterial pressure (MAP), mean pulmonary artery pressure (PAP), right (RAP) and left (LAP) atrial pressures, LV end diastolic pressure (LVEDP), LV dp/dt, cardiac index (CI), stroke index (SI), systemic (SVRI) and pulmonary (PVRI) vascular resistance indices. These parameters were measured again at 5 minutes and 20 minutes following 50 µg/kg fentanyl citrate injected intravenously over 3-minute period. After one hour, 0.5 mg/kg atropine sulfate was administered intravenously. Thirty minutes following the administration of atropine hemodynamic parameters were measured, 50 µg/kg fentanyl administered intravenously over 3-minute period, and hemodynamic parameters were measured at 5 minutes and 20 minutes. Arterial blood gases, pH and body temperature were controlled within normal limits throughout the experiment. Arterial, mixed venous and coronary sinus blood samples were analyzed for oxygen content under each condition. Regional coronary blood flow determination were made under each condition using radio-labeled microspheres employing standard techniques. The LV free wall was sectioned into three layers from which, epicardial, midwall, and endocardial blood flows were calculated using appropriate formulae. The right ventricular free wall was sectioned into two layers and flows determined for epicardial and endocardial layers. The septal wall was sectioned into three layers and appropriate flows were calculated. LV free wall metabolic rate (MVO₂) and whole body metabolic rate (VO₂) were calculated according to the Fick method.

Results. - See Tables I and II

Discussion. This investigation demonstrated a time dependent decrease in both right and left ventricular blood flows that did not appear to be totally dependent on HR or CI. Similarly MVO₂ showed a significant decrease at 20 minutes in the non-atropinized animals. The fact that atropinization of the experimental animal did not totally abolish the decrease in flows suggests that the minimal hypotension due to fentanyl had some

additive effect on the coronary blood flow. It was further demonstrated that there was no redistribution of either left or right ventricular blood flows due to fentanyl. LV contractility as evidenced by dp/dt and SI did not decrease with fentanyl. Despite the fact that coronary flow decreased with fentanyl, myocardial oxygen demand also decreased in a similar fashion. Therefore the supply: demand ration probably remained unaltered in these dogs with presumed normal coronary arteries. In conclusion, large doses of fentanyl does not decrease left ventricular contractility, does not cause redistribution of coronary blood flow and does not result in subendocardial ischemia.

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TABLE I

SELECTED HEMODYNAMICS AND MYOCARDIAL BLOOD FLOWS DURING CONTROL AND FOLLOWING FENTANYL ADMINISTRATION

Hemodynamic Parameters	Control	Following Fentanyl	
		5 min	20 min
HR	147±3.3	89±8.9**	88±9.6**
MAP	97.8±4.5	84.3±6.8	81.1±6.2*
PCWP	9.5±1.1	10.0±1.7	11.3±2.2
LV dp/dt	2614±328	2660±566	2378±417
CI	3.73±0.20	2.77±0.15**	2.88±0.15**
RV Epi	119.11±19.73	87.93±32.88	63.53±15.20*
RV Endo	84.02±12.93	72.67±20.53	50.25±9.98*
LV Epi	117.12±13.21	89.25±25.27	67.47±11.45**
LV Endo	136.53±20.64	102.16±28.21	76.55±18.83*
MVO ₂	11.87±1.67	8.34±2.38	5.63±0.35**

TABLE II

SELECTED HEMODYNAMIC AND MYOCARDIAL BLOOD FLOWS DURING CONTROL AND AFTER FENTANYL IN ATROPINIZED DOGS

Hemodynamic Parameters	Control	Following Fentanyl	
		5 min	20 min
HR	151±8.9	141±9.8	140±8.4
MAP	98.8±7.4	93.6±9.7	86.6±6.2
PCWP	10.3±1.8	8.4±1.2	10.0±1.5
LV dp/dt	2593±563	2319±431	2167±243
CI	3.37±0.31	3.30±0.25	3.12±0.16
RV Epi	113.95±18.52	87.46±14.26	78.77±14.17
RV Endo	95.26±16.46	63.72±7.22	59.07±5.03*
LV Epi	132.91±19.82	109.72±11.72	80.63±9.79*
LV Endo	140.92±23.37	115.55±11.73	92.76±8.81
MVO ₂	11.02±1.92	9.10±1.07	7.48±1.15

*p<0.05 versus control
 **p<0.01 versus control