TITLE: THE EFFECT OF ISOFLURANE AND ISOFLURANE WITH NITROUS OXIDE ANESTHESIA ON BARORECEPTOR REFLEX CONTROL OF HEART RATE IN MAN

AUTHORS: Peter C. Duke, M.D.,F.R.C.P.(C), Kathleen Hill, M.D., Sharon Trosky, R.N.

AFFILIATION: Department of Anesthesia, University of Manitoba, Health Sciences Centre 700 William Avenue, Winnipeg, Manitoba, Canada, R3E 0Z3

Introduction. In healthy subjects, isoflurane produces a dose related depression of arterial blood pressure similar to that seen with halothane and enflurane[1]. Although stroke volume is decreased with isoflurane, cardiac output is maintained near awake levels by a concommitant increase in heart rate[1]. In addition, left ventricular performance is less depressed with isoflurane. Animal studies have shown that the baroreflex remains intact during isoflurane anesthesia[1]. It is postulated that the increase in heart rate and less negative inotropic effect of isoflurane(vs.enflurane or halothane) is a result of baroreflex induced responses to decreased systemic pressure[1]. Therefore, the purpose of this study was to observe the effects of isoflurane alone or with 70% N_2O at equipotent anesthetic concentrations on baroreflex control of heart rate in man.

Methods. Baroreflex control of heart rate was quantified by relating systolic blood pressure (SBP) to the succeeding R-R interval on the electrocardiogram (expressed in milliseconds) as the blood pressure was pharmacologically elevated with angiotensin (Pressor Test) or decreased with nitroprusside (Depressor Test). The relationship between SBP and R-R interval, plotted on a beat to beat basis, is linear and by using least squares analysis, a slope and a correlation coefficient for each test is calculated. The slope represents a measure of baroreflex function and is expressed in milliseconds R-R interval change per torr increase in systolic pressure. Ten healthy unmedicated patient volunteers (age range 20-38) were studied prior to undergoing minor surgical procedures. All studies were sanctioned by our human experimentation committee. Direct arterial blood pressure and ECG were simultaneously recorded. Control Pressor and Depressor tests were performed on all subjects. The subjects were then divided equally into two groups. Group I-isoflurane and oxygen (N=5) and group 2-isoflurane with 70% nitrous oxide (N=5). Anesthesia was induced by face mask and the trachea intubated. Pressor and Depressor tests were performed at the following equi-anesthetic concentrations for both groups (expressed as MAC multiples): at 0.9,1.0 and 1.25 MAC.

Results. In the awake subjects, the Pressor test slopes are significantly larger than the Depressor test slopes. At light levels of isoflurane anesthesia (0.9 MAC) with or without N_2O there is a significant decrease in both slope values from the awake controls. At 1.25 MAC levels there is decrease in the values from awake controls. The Depressor test slopes in both groups are less depressed than the Pressor test slopes.

Discussion. With increasing depth of anesthesia, there is a dose related decrease in slope values for both tests in both groups. It is significant that during anesthesia, baroreflex responsiveness is better preserved below resting blood pressure. This is strong evidence to suggest that the baroreflex is capable of increasing heart rate in response to isoflurane induced systemic hypotension. In addition the fact that in the intact human, myocardial contractility is less depressed with isoflurane (vs other inhalational agents) adds further support to the implication that the baroreflex is partially responsible for off setting the direct depressive effect of the drug on the isolated myocardium[1]. The partial preservation of the baroreflex is responsible for maintaining cardiac output during isoflurane anesthesia.

SLOPE DATA FOR GROUP 1 & 2 SUBJECTS
(MEAN ± S.E.)

TABLE I GROUP 1 (N=5)
ISOFLURANE/O_2

	Pressor Test	Depressor Test
Awake	24.6 ± 3.1	14.1 ± 2.9
0.9 MAC	7.4 ± 2.1*	9.1 ± 2.6*
1.0 MAC	6.7 ± 2.0*	5.3 ± 1.6*
1.25 MAC	3.8 ± 1.4*	1.4 ± 1.1*

TABLE 2 GROUP 2 (N=5)
ISOFLURANE WITH 70% N_2O

Awake	25.1 ± 4.1	15.4 ± 3.1
0.9 MAC	8.9 ± 2.0*	7.2 ± 3.1*
1.0 MAC	4.2 ± 1.5*	6.9 ± 2.7*
1.25 MAC	3.4 ± 1.2*	6.6 ± 2.6*

* Significant difference from respective Pressor or Depressor awake control ($p < 0.05$) for each group