Title : CARDIOVASCULAR PERFORMANCE IN CHILDREN DURING INDUCTION: AN ECHOCARDIOGRAPHIC COMPARISON OF ENFLURANE AND HALOTHANE

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Enflurane and halothane are the 2 most widely used potent inhalation anesthetics in children. Since these agents can produce depression of ventricular performance, it is important to assess the cardiovascular effects in the pediatric age group. Echocardiography (echo), has been previously demonstrated to be an excellent non-invasive monitor of ventricular function in children receiving halothane.[1] The present study was undertaken to compare the effects of enflurane and halothane on ventricular function in children.

Methods. Nineteen (19) patients (ranging in age from 2.5 years to 12 years (mean=5 years) undergoing elective non-cardiac surgery were studied. At the preoperative visit, informed written consent was obtained from the parents. Cardiovascular and ventilatory parameters were assessed with the aid of M-mode echocardiography (Picker Systems-80 Cardiac Imager) and end-tidal gas analysis (Beckman LB-2). Each series of measurements consisted of: blood pressure (BP), pulse rate (P), M-mode echos of the left ventricle and aortic root. End tidal (ET) carbon dioxide, ET N_2O, and ET halothane or ET enflurane, were measured during induction with the appropriate infrared gas analyzers. Derived data included: mean blood pressure ($\overline{BP}$), cardiac index (CI), shortening fraction (SF), ejection fraction (EF), mean circumferential fiber shortening rate (Vcf), and the pre-ejection period/left ventricular ejection time (PEP/LVET).

Measurements were made with the patient awake (control) and ninety (90) minutes following intramuscular premedication with secobarbital 4mg/kg and morphine 0.1mg/kg (=post premed). With the child breathing N_2O/O_2 (3/2), equipotent concentrations of enflurane (N=10) or halothane (N=9) were administered and increased at 2 minute intervals. At the maximum anesthetic concentration for each agent (enflurane or halothane) intravenous atropine 0.02 mg/kg was administered and the measurements were then repeated. For the entire study period ET CO_2 was maintained between 5.2-5.5%.

Results. (Table 1) Increasing concentrations of either enflurane or halothane significantly ($P<0.05$) depressed ventricular performance in a dose dependent fashion. At ET enflurane=2.45%, BP, CI, and EF decreased by 14, 24% and 21% respectively. At the equivalent halothane concentration (ET=1.12%), BP, CI and EF decreased 22%, 31% and 20% respectively. However, at equipotent concentrations, no significant ($P>0.05$) differences were noted between the anesthetics. Shortening fraction (SF) and mean normalized rate of circumferented fiber shortening (Vcf) showed parallel decreases with each agent. Acute augmentation in P (atropine) resulted in improvement in CI and all rate dependent variables for both the enflurane and halothane groups. However, the ejection phase indices of myocardial performance (EF, SF, PEP/LVET) still showed depression.

It is concluded that both enflurane and halothane significantly depress ventricular function to a similar degree in children undergoing surgical procedures.

Reference.

1. Barash, P. et al.: Ventricular function in children during halothane anesthesia: An Echocardiographic evaluation. Anesthesiology 49:79-85, 1978.

Table 1. Cardiovascular Data (Mean ± SEM)

	AWAKE (CONTROL)	
	ENFLURANE (N=10)	HALOTHANE (N=9)
P(BPM)	102 ± 5.3	99.2 ± 9.8
$\overline{BP}$(mmHg)	74.8 ± 2.7	72.0 ± 2.6
CI(cc/M^2/min)	4187 ± 270	4059 ± 416
SF	0.31 ± .02	0.31 ± .01
Vcf(circs/sec)	1.24 ± 0.09	1.21 ± 0.04
EF (%)	57.9 ± 2.5	57.4 ± 1.4
PEP/LVET	0.238 ± 0.004	0.224 ± 0.007

	MAXIMUM CONCENTRATION OF ANESTHETIC	
	ENFLURANE End-tidal=2.45%	HALOTHANE End-tidal=1.12%
P(BPM)	102 ± 6.5	87.8 ± 4.6
$\overline{BP}$(mmHg)	65.2 ± 1.8	55.8 ± 1.9
CI(cc/M^2/min)	3170 ± 451	2796 ± 366
SF	0.22 ± .05	0.23 ± .05
Vcf(circs/sec)	0.84 ± .09	0.87 ± .07
EF (%)	45.8 ± 2.9	46.2 ± 2.6
PEP/LVET	0.286 ± .017	0.302 ± .013