Title: HALOGENATED ANESTHETICS AND REVERSAL OF NEUROMUSCULAR BLOCK

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Introduction. Several studies in recent years have compared the changes in heart rate and rhythm during reversal of neuromuscular blockade. All studies, however, totally ignored the influence that volatile anesthetic agents used might have had on these changes. It is possible that the various inhalation anesthetics used during surgery could have different modifying effects on these changes[1]. We compared the influence of two commonly used volatile anesthetics on changes in heart rate and rhythm during the reversal of neuromuscular blockade.

Methods. Institutional approval of the study involving human beings was obtained. 48 adult patients (ASA Class I or II) between 20 to 69 years of age undergoing elective surgery requiring the use of non-depolarizing muscle relaxants were studied. After induction with thiopental, anesthesia was maintained either with halothane (Group H, n=24) or enflurane (Group E, n=24) in a mixture of nitrous oxide-60% and oxygen 40%. Ventilation was controlled. Pancuronium was used to provide muscle relaxation. Each group was divided into 2 sub-groups of 12 each depending upon mode of reversal of neuromuscular block. 12 patients in each group were given atropine 1.2 mg followed 5 minutes later by neostigmine 2.5 mg (sub groups HA and EA). In the remaining 24 patients a mixture of atropine 1.2 mg and neostigmine 2.5 mg given as a rapid intravenous injection (sub groups HAN and EAN). Continuous EKG recording was obtained during the reversal and pulse rates blood pressure were recorded once every minute for 10 minutes after initial injection of anticholinergic or anticholinergic-anticholinesterase mixture. Administration of halogenated anesthetic was continued during reversal process and any non-surgical stimulation was avoided. Mechanical ventilation was maintained until the end of the study to maintain $PaCO_2$ between 30-40 torr (confirmed by arterial blood gas analysis). In each patient the heart rate prior to injection of either anticholinergic or anticholinergic-anticholinesterase mixture is referred to as baseline heart rate, maximum increase from this rate during the study period is referred to as peak tachycardia. Difference between peak tachycardia and the minimum heart rate recorded after neostigmine in each patient is labelled peak-bradycardia. Baseline heart rates and maximum changes in heart rates (peak tachycardia and peak bradycardia) from each sub-group were compared with all other sub-groups using one way analysis of variance to determine statistical significance.

Results. Table 1 shows the baseline heart rate (mean ± SEM bpm and maximum increase and decrease during the reversal of neuromuscular blockade in 48 patients studied. Mean baseline heart rate varied between 75 to 87 beats/-min. Differences between the groups were not statistically significant.

Peak Tachycardia. Maximum increase in heart rate occured 2 minutes after injection of atropine in all patients both when injection of atropine preceeded neostigmine and when the two drugs were given simultaneously.

The patients who received halothane developed marked tachycardia soon after the injection of atropine (sub-group HA). The rise in pulse rate after atropine in patients receiving enflurane (sub-group EA) was much less marked and the difference in the peak tachycardia between these two groups (HA vs EA) was statistically significant ($P < 0.001$). When atropine was injected in a mixture with neostigmine, the initial tachycardia was significantly different only between the two halothane sub-groups (HA vs HAN). There was no statistical difference in the peak heart rates between the enflurane sub-groups (EA vs EAN).

Peak Bradycardia. Heart rates dropped after neostigmine given either separately or combined with atropine in all groups. However, the fall in the heart rate (peak bradycardia) was especially marked in patients who received halothane as the primary anesthetic (groups HA and HAN). Statistically significant difference was observed between the groups who received halothane compared to those given enflurane, irrespective of the mode of administration of neostigmine (sub-group HA vs EA and HAN vs EAN). Statistical significance was also observed between the two halothane sub-groups (HA vs HAN). However, there was no statistically significant difference between the two enflurane sub-groups (EA vs EAN).

Cardiac Rhythm. Cardiac dysrhythmias were very rare in all the groups. None of them had significant haemodynamic effect.

Discussion. This study has shown that the fluctuations in heart rates during reversal of neuromuscular blockade is significantly modified by the type of volatile anesthetic used. The swings were significantly more marked during halothane anesthesia compared to enflurane anesthesia. Electrophysiological mechanism of this difference is a matter of speculation.

References.

1. Samra SK, Cohen PJ: Modification of chronotropic response to anticholinergics by halogenated anesthetics in children. Canad Anaest Soc J 27:540, 1980.

CHANGES IN H.R. DURING REVERSAL OF NEUROMUSCULAR BLOCK (MEAN ± SEM) B.P.M.

SUB-GROUP	BASELINE H.R.	CHANGES IN H.R. PEAK TACHY	PEAK BRAD
HA	76±2.5	33±3.7	50±14.5
EA	78±3.5	14±3.2	26± 7.5
HAN	75±3.8	19±3.6	36±10.4
EAN	87±3.7	12±2.0	22± 6.4

STATISTICAL ANALYSIS: No significant difference in baseline heart rate (H.R.)

PEAK TACHYCARDIA (TACHY):HA vs EA-P <0.001; HAN vs EAN-P=0.46; HA vs HAN-P< 0.01; EA vs EAN-P=0.23

PEAK BRADYCARDIA:HA vs EA-P< 0.001;HAN vs EAN-P <0.002; HA vs HAN-P< 0.001; EA vs EAN-P=0.35