A450

TITLE: EFFECT OF ENFLURANE, HALOTHANE, ISOFLURANE AND NITROUS OXIDE ON CORTICAL MAGNETIC MOTOR EVOKED POTENTIALS

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Inhaled anesthetic agents cause changes in the EEG and sensory evoked potentials. Clinical experience suggests similar effects on motor evoked responses (MMEP). In order to characterize this effect, an institutionally approved study was conducted in monkeys.

Methods Five cynomologous female monkeys (3.3-4.6 kg) were anesthetized by ketamine (15 mg/kg I.M.) followed by infusion (10 mg/kg/hr) in crystalloid solution (4 cc/kg/hr). Ventilation was controlled to an end tidal CO2 of 35-40 mmHg and esophageal temperature maintained 36-36.5 deg C. ECG, blood pressure and pulse oxygen saturation were monitored.

MMEP were obtained using cortical stimulation with a Cadwell MES-10 stimulator (Kennewick, WA) at 80-90% power. Responses were acquired from forelimb muscles using subdermal needles by a Biologic Navigator (Mundelein, IL) with amplification of 1000 and filtration 1-3000 Hz. Onset (time from stimulation to the first EMG deflection), amplitude and threshold (smallest stimulation power with ability to elicit a response) were acquired at various concentrations of nitrous oxide (N2O), enflurane (ENF), isoflurane (ISO) or halothane (HAL) in oxygen/air. All animals were studied with all agents.

Results MMEP was lost at subMAC concentrations of the agents. Shown below are the fraction of animals responding at various MAC values (monkey MAC). As is seen, the effect varies with the agents (N2O > ISO > ENF > HAL). Onset had a tendency to increase and amplitude to decrease in a dose related fashion.

Discussion This study confirms the clinical impression that MMEP is lost at subMAC concentrations suggesting inhaled agents may not be suitable as sole agents or as supplements to intravenous anesthesia during surgical monitoring.

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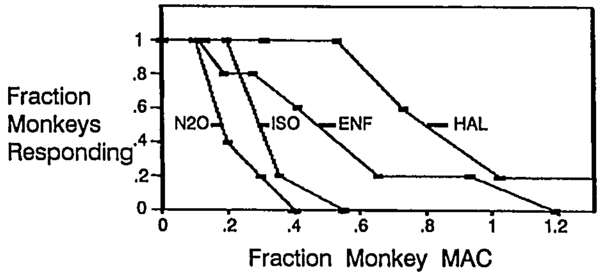

A451

TITLE: A COMPARISON OF ARTIFICIAL NEURAL NETWORKS AND CLASSICAL STATISTICAL ANALYSIS.

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Introduction: Artificial neural networks (ANN) have proven useful in a wide variety of pattern recognition tasks in anesthesia monitoring technology. ANNS are usually presented to users as a "black box" whose complex inner workings mysteriously transform inputs into classified outputs. Theoretically, ANN function can be compared with classical statistical approaches such as multiple regression and discriminant analysis. However, ANN research and application results are usually reported without comparison to other methods. We have directly compared ANN classification to discriminant analysis of EEG spectral signatures.

Methods: A three layer feed forward perceptron network (40 input nodes, six hidden nodes, three output nodes) was used as a pattern classifier to compare with discriminant analysis of EEG spectral signatures. With institutional approval, general anesthesia was mask induced in ten dogs using oxygen, nitrous oxide (N2O) and isoflurane. Following induction and intubation, N2O was discontinued and an IV line started for maintenance fluids and drugs. EKG electrodes, arterial catheter and infrared end tidal gas analysis monitors were applied. Pancuronium was used for neuromuscular blockade, mechanical ventilation kept end tidal CO2 between 35 and 40 Torr, and blood pressure was maintained within 20% of baseline with phenylephrine when necessary. Subdermal needle electrodes were placed in the frontal and occipital regions of the left and right cerebral hemispheres. End tidal isoflurane concentration was initially set at 0.7% and increased by 0.7% every 15 minutes to achieve three stable anesthetic levels (0.5, 1.0 and 1.5 MAC). For each dog at each of three anesthetic levels, a 20 second EEG epoch was digitized at 200 Hz and analyzed for spectral content 256 points at a time using software written in C. The average spectral signature of each 20 second epoch was stored as a 40 point array to train and test the ANN to categorize each signature as either 0.5, 1.0 or 1.5 MAC. The ANN was trained on nine out of ten data sets and tested on the excluded data set. This was done ten times so that each epoch signature was excluded and tested for once. Discriminant analysis was performed on the same data sets using SPSS software (nine cases were used to calculate coefficients of the discriminant function, and the excluded case was classified accordingly).

Results: The trained ANN was able to correctly identify the anesthetic level of unknown EEG epochs with an overall accuracy of 77% as shown in Table I. The overall accuracy using discriminant analysis was 40%. Although the trained ANN performed much better than discriminant analysis, the correlation between the two approaches is clearly established by the results for individual classes as shown in Table I.

Discussion: Theoretically, data classification using multi-layer perceptrons can be compared to discriminant analysis. Our results confirm this model of ANN function since highest accuracy was achieved for both techniques in the 0.5 MAC category with the least accurate predictions occurring for both techniques in the 1.0 MAC category. Since discriminant analysis is based on assumptions that the underlying inputs have a gaussian distribution, the superior performance of the ANN may be attributable to greater suitability for classifying nonlinear processes.

Table I. Comparative Accuracy of ANN vs. Discriminant Analysis

Anesthetic Concentration	0.7%	1.4%	2.1%
% Correctly Classified by ANN	100	50	80
% Correctly Classified by Discriminant Analysis	70	10	40