Title : THE ELECTROENCEPHALOGRAM UNDER FENTANYL-N_2O ANESTHESIA

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Introduction. High-dose fentanyl-nitrous oxide anesthesia is becoming popular because of its minimal deleterious effects on the cardiovascular system, ease of administration, and controllability.[1,2] The modest changes of the vital signs make evaluation of the depth of anesthesia more difficult, however. One modality which might be of assistance in monitoring depth is the electroencephalogram (EEG). Because little has been reported on the EEG effect of this anesthesia technique, we recorded the EEG in dogs who received step doses of i.v. fentanyl up to 100 micrograms (mics)/kg while maintained on N_2O-O_2.

Methods. We anesthetized seven unmedicated mongrel dogs, weighing 11-22 kg, with halothane (H)-N_2O(70%)-O_2(30%). They were intubated and femoral arterial and venous lines were secured. Recording screws were fixed into the skull in the posterior midline and left parietal area. Temperature was monitored and controlled by rectal probe. Blood pressure, EKG, and single-channel EEG were recorded along with on-line frequency analysis of 32-second epochs by the University of Iowa Bioengineering Laboratory's 518C Fast Fourier Frequency Analyzer.[3] After a short recording period, the dog received pancuronium 0.5 mg/kg and was mechanically ventilated. H was turned off, N_2O 70% was continued, and the ventilator was set to maintain PCO_2 in a range of 35±5 torr, determined by repeated arterial blood gases. A period of one hour for elimination of H followed. Fentanyl was then administered by slow i.v. push in steps to total doses of 10, 25, 50, 75, and 100 mics/kg. A tail pinch was administered at each step to determine pulse and blood pressure response. After a short equilibration period at each step, the EEG was recorded and analyzed. The animal was killed by i.v. KCl and the flat EEG was recorded for noise correction. Using these data, we compared the average amplitude of the recorded EEG and the EEG frequency distribution generated by the frequency analyzer during H-N_2O, N_2O alone, and following each step dose of fentanyl.

Results. All pulse and blood pressure responses to tail pinch which were present under N_2O anesthesia alone were abolished in all dogs when the dose of fentanyl reached 25 mics/kg. A typical EEG during 1.5% H anesthesia (no response to stimuli) is shown in Fig. 1, along with the frequency analysis of this EEG. The EEG is brain electrical activity recorded as changes from base line (amplitude) and number of changes per second (frequency; Hz). The wavy line seen is the summation of many frequencies in the range of 1-25 Hz, each with its own amplitude. Frequency analysis breaks down the summed EEG and shows the relative contribution of each frequency to the whole. Fig. 1 shows that in the EEG for deep H anesthesia, a relatively large part of the signal is made up of frequencies in the range of 12-20 Hz (EEG activation). The large component of high frequency waves disappeared rapidly when H was discontinued and the EEG resembled Fig. 2 (N_2O alone) within 5 minutes and remained stable for the entire H elimination period. Fig. 3 is the patterns seen at N_2O-fentanyl 50 mics/kg, and Fig. 4 is the same for N_2O-fentanyl 100 mics/kg. In Figs. 2, 3, and 4, in contrast to Fig. 1, most of the EEG signal is in the range of 1-12 Hz. As the fentanyl dose increased, a tendency was observed for the lower EEG frequencies (1-12 Hz) to become more prominent and the average amplitude to decrease, but no fentanyl dose was significantly different from the N_2O alone pattern. This was verified by doing 3 additional dogs with the same protocol, except using doses of 1, 2.5, 5, 7.5, and 10 mics/kg to confirm that we did not miss a period of EEG activation by starting with a dose of 10 mics/kg.

Discussion. The EEG does not significantly change during fentanyl-N_2O anesthesia in a manner which parallels increasing dose of fentanyl when observed for average amplitude or frequency distribution. This limits the use of the EEG for determining depth of anesthesia while using this technique.

References.

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