Title : EEG DURING RAPIDLY CHANGING HALOTHANE OR ENFLURANE

Authors : N. Ty Smith,M.D.; I.J. Rampil,M.S., F.J. Sasse,M.D.; B.H. Hoff,M.D.; D.C. Flemming;FFARCS

Affiliation: Department of Anesthesiology, University of Wisconsin, Madison, Wisconsin 53792, Department of Anesthesia, University of California, San Diego, California 92161

Introduction The EEG has already shown considerable promise as a monitor of anesthesic depth when halothane (H) is given as the sole agent. This study was designed to extend these observations further and to provide preliminary answers to the following questions: 1) Is there an enflurane (E) produced EEG pattern which is easily interpreted and which changes in a predictable fashion with changes in concentrations of E? 2) Can the EEG follow rapid changes in the concentrations of either agent?

Methods Anesthesia was induced in eight mongrel dogs by H-O2 or E-O2 (10 studies) by mask and maintained with the same agent via an endotracheal tube. End-tidal CO2 and rectal temperature were maintained within normal limits. The EEG was obtained from either a bifrontal or a frontal-occipital lead. The signal was Fast Fourier Transformed by a Nicolet Med-80 computer, which displayed the results as a compressed spectral array, a mountain and valley picture recorded on a XY plotter. To determine the ability of the EEG to reflect the depth of anesthesia and to follow rapid changes in anesthetic concentrations, we used a pseudo random testing sequence (PRBS) . The agent was administered in pulses, that is, it was either off or on at a preset value (3.5% for H; 5-6% for E). The duration of the off and the on pulses was randomized, but the sequence was repeated every 26 min., for three sequences in each animal.

Results.Halothane. Each dog had an "H band," whose frequency varied greatly with H(Fig. 1). This band was able to follow rapid changes in H concentrations, and shifted between 19.4 and 27.0 Hz during the PRBS sequences. Enflurane. The typical pattern produced by E in the dog consists of a high-amplitude low-frequency band, plus a second low-amplitude, high-frequency band (Fig. 2). The upper border of the higher frequency band was often much more discrete than the lower border, giving it the appearance of an "edge," or an envelope. This frequency envelope changed inversely with the concentration, and the pattern was a damped replica of the input pattern. The longer the on or off pulse, the greater the change in frequency of the envelope.

Discussion.Halothane. The H band seen in the dog is analogous to that seen in man, although in the former it is often not as distinct or as consistent in its occurance during rapidly changing concentrations. However, it does have the same ability to reflect rapidly changing concentrations of H(Fig. 1). Enflurane. Although the upper band is not as reliably distinct as with H, the presence of a relatively sharp upper cutoff is encouraging. This means that an envelope can be traced over the maximum frequency as an indicator of the depth of anesthesia. Although this tracing can be done visually, precision and quickness would not be easy under hectic conditions of the operating room. A computer can track the edge of the highest frequency and display a number, which is easier to read and to interpret.

Supported in part by Ohio Medical Products; Nicolet Instrument Corporation; Department of Anesthesiology, University of Wisconsin; and the Medical Research Service, Veteran's Administration.

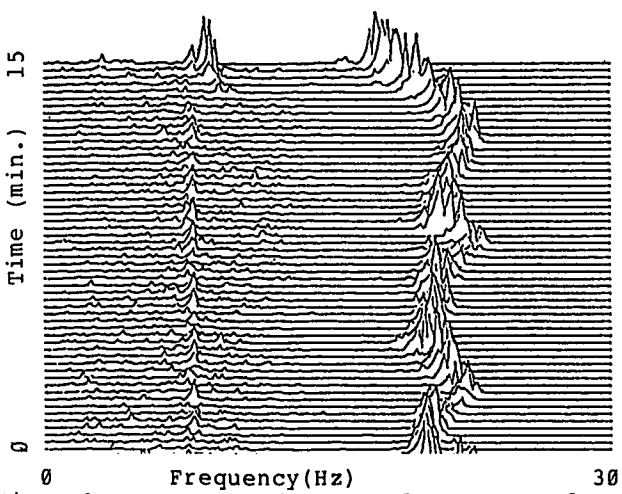

Fig. 1. Compressed Spectral Array of EEG during halothane PRBS. The "H" band is evident above 19 Hz.

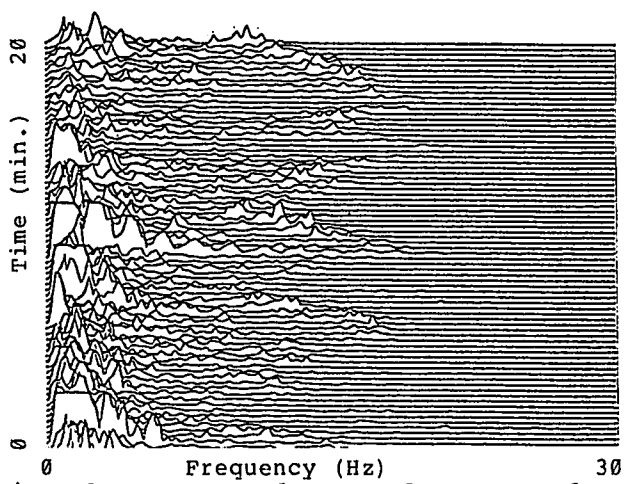

Fig. 2. Compressed Spectral Array of EEG during enflurane PRBS. Almost all of the energy is present below 25 Hz.