Anesthesiology
V 75, No 3A, Sep 1991

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TITLE: BISPECTRAL ANALYSIS OF EEG MAY PREDICT ANESTHETIC DEPTH DURING NARCOTIC INDUCTION

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Spectral edge frequency (SEF) of electroencephalography (EEG) is a variable considered a measure of "anesthetic depth" (1,2). The purpose of this study is to determine whether bispectral analysis, a new technique which quantifies interfrequency phase coupling of the EEG, is superior to SEF for predicting hemodynamic responses to laryngoscopy during induction with sufentanil or alfentanil.

The study was approved by the Subcommittee on Human Studies. 43 adult patients scheduled for elective noncranial surgery gave informed consent and were studied. Five Grass E5 gold cup electrodes were placed on each patient's scalp in a fronto-parietal montage (FP1, FP2, P3, P4) referred to the vertex. Patients received premedication with oral diazepam (0.05 - 0.15 mg/kg) and were induced with thiopental (4.0 - 6.0 mg/kg) and 60% nitrous oxide in oxygen, followed by vecuronium (0.1 mg/kg). Each patient was then randomly administered one of five dose regimens: normal saline; alfentanil 15 mcg/kg (1A) or 30 mcg/kg (1B); sufentanil 0.5 mcg/kg (2A) or 1.5 mcg/kg (2B). Laryngoscopy was performed after 3 minutes. Brachial blood pressure was measured every minute with a cuff device (Dinamapp). A change of 20% or greater in mean arterial pressure in response to intubation defined "responders" (Resp). The EEG was recorded continuously using a prototype portable system (Biometrak Corp.). All EEG parameters were derived for the minute before intubation and were compared to the blood pressure responses. Spectral edge frequency (SEF) was calculated using the method of Rampil (1). For bispectral analysis (Bis) phase locked energy in the delta band was subtracted from total delta energy and is expressed as a ratio relative to the mean bispectral density of the 0-32 Hz band. Responders and non-responders (Non-resp) were compared using Student's unpaired t-test. Differences due to dose regimens were examined with ANOVA.

Table I identifies the responders and nonresponders to intubation among the five drug groups. Table II shows that Bis but not SEF was significantly different for the two hemodynamic response groups. Analysis of covariance demonstrated that the differences in Bis between Resp and Non-resp were independent of dose group effects. The sensitivity and specificity for predicting responders, and the overall accuracy of the EEG are shown in Table III.

These data support the concept of a relationship between the EEG and depth of anesthesia which is independent of anesthetic agent and dose. Our study suggests that assessment of phase coupling within the EEG by means of bispectral analysis may enhance the overall value of the EEG for intra-operative monitoring of anesthetic depth and warrants further investigation.

Table I:	Saline	1A	1B	2A	2B	TOTAL
Resp	7	8	6	6	0	27
NonResp	1	1	3	3	8	16

Table II:	Resp	Non-resp
SEF (Hz)	11.6 ± 2.1	11.4 ± 2.1
Bis (%)	102 ± 80	248 ± 141 *

* = p<0.001

Table III:	Sens	Spec	Acc
SEF	86	28	64
Bis	94	63	82

References
1. Anesthesiology 67:139-42, 1987.
2. Anesthesiology 67:A401, 1987.

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TITLE: CORRELATION BETWEEN ELECTROCARDIOGRAPHIC CHANGES AND INTRACRANIAL BLOOD FOLLOWING SUBARACHNOID HEMORRHAGE

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Introduction: Electrocardiographic changes are frequently present in patients following subarachnoid hemorrhage (SAH).[1] The etiology and significance of these changes remains unclear. The purpose of this study was to assess whether there is a correlation between incident and type of ECG change and the amount of intracranial blood following SAH.

Methods: After IRB approval, the charts and CT scans of all patients admitted with an acute SAH and who had a CT scan and ECG within 96 hours of their bleed were retrospectively reviewed. CT scans were graded according to the classification described by Fisher:[2] Group I, no blood detected. Group II, diffuse deposition or thin layer (<1mm thick). Group III, localized clots or blood ≥1mm thick. Group IV, intracerebral or intraventricular clots. Any ECG changes of the P, U or ST-T wave and abnormality of conduction, rate or rhythm were documented. Patient outcome and the development of vasospasm were noted. Statistical analysis was performed using Chi Square Analysis. P<0.05 was considered significant.

Results: 70 patients were studied, 47 females, 23 males, mean (±SD) age of 51±13 yr. 43% of all patients had an abnormal ECG. There was a statistically significant increase in the incidence of ST-T wave changes with increased intracerebral blood (Table). Our study showed no correlation between the amount of blood on CT scan and clinical grade status following SAH. Patients with higher CT grades had a greater incidence of vasospasm and a worse outcome.

CT Grade	Normal ECG	ST or T wave Changes
I	2	1
II	15	1
III	12	3
IV	19	17*

* P<0.05 compared to Grade II & III

Discussion: ECG abnormalities and the amount of intracranial blood have both been shown to be predictors of patient outcome following SAH.[3] In contrast to this previous study, we found a significant increase in the occurrence of ST-T wave changes in patients with increased amounts of intracerebral blood on their CT scan following SAH.

References:
1. Manninen et al., J Neurosurg Anesth 2:16-22, 1990; 2. Fisher et al., Neurosurgery 6:1-9, 1980; 3. Brouwers et al., Stroke 20:1162-67, 1989.