TITLE: PACING ARTIFACTS CREATE "PSEUDO-ISCHEMIA" IN PROCESSED EEG IN PATIENTS DURING CARDIOPULMONARY BYPASS

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Introduction. The incidence of neurologic complications after cardiopulmonary bypass (CPB) increases with advancing age (1). The processed electroencephalogram (EEG) has been proposed as a monitor of cerebral ischemia (2). Unfortunately the electrocardiogram (ECG) can be detected in the EEG. We determined whether pacing artifact presents itself symmetrically (obscuring ischemia) or asymmetrically (creating "pseudo-ischemia").

Methods. After IRB approval and informed consent, the processed EEG (CerebroTrac™ 2500, SRD) was continuously monitored in 7 patients with preexisting cerebrovascular disease (stroke, TIA, or carotid bruit) presenting for CPB. Pre-gelled, adhesive, silver/silver chloride electrodes (ConMed® Premie) were placed over both mastoids, bifrontally, and on the forehead after the skin preparation recommended by the manufacturers. Electrode contact impedances were less than 5,000 ohms. The spectral edge frequency (SEF) and amplitude were recorded before and after A-V sequential pacing at the end of CPB. Data were analyzed using analysis of variance ($p<0.05$ considered significant).

Results. The results are presented in the Table. The pacing artifact presented itself as an asymmetric increase in SEF with well-defined parallel lines in the density spectral array which occurred at frequencies that were multiples of the pacing frequency. The interference pattern disappeared when the pacer was turned off.

Conclusions. A-V sequential pacing produced a characteristic pattern in the density spectral array and an asymmetric increase in SEF which could be falsely interpreted as ischemia. In fact, the pacing artifact rendered the EEG uninterpretable.

Table

	Pacer* Off	On
Left SEF	9.36±1.14	16.43±4.08**
Right SEF	9.36±1.97	14.00±3.43**
▲ SEF+	0.6(0-1.5)	4.3(1.5-10.5)

* mean ± S.D.

**significant (analysis of variance), off vs on, P = .0003

+Left vs right or right vs left; magnitude (range)

References:

1. Gardner et al. Ann Thorac Surg 40:574, 1985
2. El-Fiki, Fish. Anesthesiology 67:575, 1987

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TITLE: DEVELOPMENT OF AN AUTOMATED LASER INTERRUPTER FOR THE HELIUM PROTOCOL

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Various techniques have been developed to guarantee effective ventilation and reduce the risk of airway combustion during CO_2 airway laser surgery. The helium protocol[1] allows use of clear polyvinylchloride endotracheal tubes by limiting oxygen concentration, excluding nitrous oxide, and using helium. To prevent accidental violations of the protocol, a laser interrupter was developed for electronic enforcement.

Of 3 prototypes, the first was designed in software using a laptop computer with an analog-to-digital converter. Monitoring an O_2 monitor, this design disabled the laser by means of a relay to open a "door interlock" connection on the laser if the O_2 concentration was excessive.

The speed of response after pressing the O_2 flush valve was measured using two O_2 monitors. With 30% initial O_2 and 40% threshold, the time from continuously pressing the flush valve to laser interruption was averaged over 4 trials. In Test 1, an Ohmeda 5100 sensor in the inspiratory limb was compared to the Datex PB254 with sidestream sampling from the Y-piece. In Test 2, the fresh gas line was placed so that the gas would flow directly over the in-line sensor and into the panel inlet of the PB254.

Electronic circuitry was then designed to detect the O_2 flush from the fresh gas flow rate, based on a sensor output from an Ohmeda 5420 tidal volume monitor with spirometer cartridge in the fresh gas flow line. Speed of response was also observed. The current version uses only simple electronic circuitry with 3 lights to indicate whether the laser is enabled or disabled because of excessive O_2 or N_2O concentrations, or detection of an O_2 flush.

In Test 1, the time to interruption was 2.84 s with the galvanic in-line monitor and 6.09 s with the PB254 monitor; in Test 2, 2.43 s (galvanic) and 2.67 s (PB254). With fresh gas flow measurement circuitry, interruption is immediate.

Versions of this laser interrupter have been in use in our institution for more than 9 months with occasional valid interruptions and no laser fires.

While O_2 sensors effectively detect slowly changing gas mixtures, the O_2 flush presents a rapid change. Fresh gas flow measurements quickly detect the O_2 flush with no modifications to the valving of the anesthesia machine. A simple electronic system that offers assistance to the clinician utilizing the helium protocol during anesthesia for CO_2 laser surgery has been developed.

Reference.

1. Anesthesiology 68:801-804, 1988.