TITLE: THE EFFECT OF ETHANOL VAPOR ON THE DETECTION OF INHALATIONAL ANESTHETICS USING INFRARED AND PIEZOELECTRIC MONITORS.

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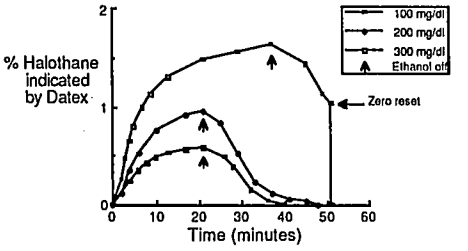
Concerns for patient safety have prompted the widespread use of inhalational anesthetic monitors. Methods which are currently available for monitoring anesthetic vapours include infra-red (IR) absorption spectrophotometry and piezoelectric microbalance (PEM) techniques. Ethanol absorbs IR radiation and also adheres to the surface of the coated crystals used in PEM monitors.[1] Consequently, exhaled ethanol can produce erroneous readings in monitors that utilize these principles.[1,2] We sought to determine the magnitude and duration of the interaction of ethanol with IR and PEM monitors.

Two IR monitors (the Datex Capnomac 2 and the SensorMedics LB-2 medical gas analyser) and one PEM monitor (the Vital Stat Agent Monitor) were studied. The digital displays for halothane were selected and the analysers were exposed to ethanol vapor. Four concentrations of ethanol vapor, corresponding to blood concentrations of 0, 100, 200 and 300 mg/dl, were used. To obtain each vapor, a standard solution of ethanol was placed in an ethanol breath simulator (Toxitest ABS 120, Federal Signal Corp, IL), an instrument used to calibrate breathalysers. The solution was then vaporized in air at a flow rate of 2 L/min. The analysers' outputs were recorded each minute while sampling the vapor. When the outputs from the monitors stabilised, the ethanol was discontinued. The outputs were then recorded each minute until they returned to baseline. The concentration of ethanol in the vapor was confirmed using an infrared analyser (Intoxilyser 5000, CMI Inc., CO). After the response to ethanol was observed, a standard gas containing 1.5 % halothane was introduced.

We found that ethanol alone produced a dose-related increase in the output of the Datex monitor (figure). The 0, 100, 200 and 300 mg/dl solutions produced maximum outputs of 0, 0.6 ± 0.1, 1.1 ± 0.1 and 1.6 ± 0.2 vols % respectively. When ethanol was discontinued, the outputs slowly returned to baseline (figure). In contrast, ethanol minimally affected the readings of the Vital Stat and the LB-2 monitors (< 0.1 vol %).

We found, in addition, that the Datex monitor underestimated the halothane concentration in the standard gas if an automatic zero reset occurred during the washout of ethanol. The monitor regained accuracy after the next reset provided that all ethanol had been completely washed out by that time.

IR monitors are known to be affected by exhaled ethanol.[1] We have shown that (1) the magnitude of this interference varies with the IR monitor used, (2) ethanol can produce a prolonged interference in the Datex monitor, (3) following exposure of the Datex to ethanol, dangerous underestimation of delivered anesthetic concentration can occur after the analyser's automatic reset, and (4) the Vital Stat Monitor is minimally affected by ethanol vapor.



References: 1. Biomed Instr and Tech 23:461-97, 1990
2. Anaesthesia 45:232-4,1990

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Title: Clinical evaluation of the Monitron™ cardio-respiratory monitor: Minimizing false alarms

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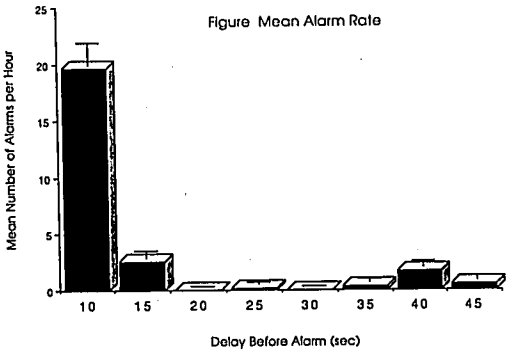
Introduction: Epidural, intrathecal, and patient-controlled intravenous administration of opioids have improved the quality of postoperative analgesia compared to traditional intermittent intramuscular administration.[1,2] Nevertheless, these patients continue to be at risk for opioid-induced depression of respiratory drive. Reliable noninvasive monitoring of cardio-respiratory function may greatly facilitate the care of postoperative patients who receive specialized methods of pain relief. Current methods include observation in intensive care or intermediate care units, increased nursing surveillance in ward beds, and a variety of electronic apnea monitors. The high rate of "false alarms" when using electronic monitors limits their usefulness. The Monitron™ cardio-respiratory monitor is a wireless, remote telemetry monitor which employs piezo-electric pressure sensors to detect abdominal wall movement. Our initial clinical impression was that this monitor also had a high rate of false alarms, but we suspected that the false alarm rate could be minimized by slightly increasing the period of time between sensing an alarm condition and actually activating the alarm.

Methods: Eighty-eight consecutive adult postoperative patients were studied during their recovery room stay after obtaining institutional review board approval and individual informed consent. The patients were randomly assigned to one of eight study groups. All patients were continuously monitored with pulse oximetry (N-200, Nellcor, Hayward, CA). The Monitron™ was programmed with a time delay before sounding an alarm for apnea according to study group: 10, 15, 20, 25, 30, 35, 40, or 45 seconds. An investigator recorded each alarm sounded and checked the patient to determine whether it was a "false alarm" (absence of apnea and presence of SaO2 > 90%).

Results: The study groups were well matched for age, sex, height, weight, ASA physical status, and site of operation. There were no "true positives"(an alarm associated with apnea, bradypnea, or arterial desaturation) or "false negatives"(apnea, bradypnea, or arterial desaturation without an alarm) noted. Every alarm recorded represented a "false positive", or "false alarm". The number of false alarms per hour for each time delay setting are shown in the figure.

Conclusions: A time delay of 20 seconds appears to virtually eliminate false alarms. In the event of a true positive alarm condition, this 20 second delay would probably not be clinically significant.



References: 1. Cousins MJ, Mather LE: Intrathecal and epidural administration of opioids. Anesthesiology 61:276-310, 1984 2. Eisenach JC, Grice SC, Dewan DM: Patient controlled analgesia following cesarean section: A comparison with epidural and intramuscular narcotics. Anesthesiology 68:444-448, 1988