Title: TEFLON MEMBRANES DO NOT ELIMINATE HALOTHANE INTERFERENCE WITH TRANSCUTANEOUS OXYGEN ELECTRODES

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Introduction: Continuing experience and technical improvements in transcutaneous oxygen ($TC-O_2$) electrode systems have encouraged continuous tissue oxygen monitoring during general anesthesia. Since all commercially available $TC-O_2$ systems are polarographic and use a Clark electrode, however, they are subject to interference by gaseous molecules which can be reduced at the cathode. Careful choice of electrode membrane material and thickness could minimize interference by anesthetic gases. This study tested the concept that substituting Teflon for polypropylene membranes would eliminate halothane interference, previously described[1].

Methods: Two Narco-AirShields (Hatboro, PA) Model TC-075-1 Transcutaneous Monitor Systems were used for this in vitro study. Duplicate electrodes each with a 25 μm diameter platinum cathode and a 5.5 mm silver anode were used, one probe covered with a 20 μm polypropylene membrane and the other with a 25 μm Teflon PTFE membrane, both supplied by the manufacturer. Membranes were separated from the glass-covered electrode by a thin film of electrolyte solution. Electrode polarization was maintained at 600 mV and temperature at 44.4-44.5°C, with electrodes mounted in a test block and exposed to the same gas source simultaneously. Prior to each test, electrodes were polarized, zeroed, and calibrated with air after showing stability for a minimum of 24 hours. Gas mixtures were provided at flow rates of 1-3 l/min by an anesthesia machine with oxygen analyzer mounted at the fresh gas outlet. Indicated $TC-O_2$ readings were taken directly from the digital display of each monitor.

Results: Exposure of the polypropylene membrane system to halothane produced a rapid rise in indicated $TC-O_2$ despite constant oxygen partial pressure within 20, 10, or 5 minutes after beginning 0.5%, 1%, and 3% halothane, respectively (figure). By 3 hrs., a rise of 25 mmHg was seen for 0.5%, 90 mmHg for 1%, and 300 mmHg for 3% halothane, all in 21% O_2, balance N_2O.

No change in indicated $TC-O_2$ was seen with the Teflon system after 2 hours of 0.5% halothane in N_2O-O_2. However, $TC-O_2$ rose by 25 mmHg after 30 minutes of 3% halothane and by 6 mmHg after 120 minutes of 1% halothane in 21% O_2, balance N_2O.

Neither enflurane nor isoflurane at concentrations of 1 or 3% produced a significant discrepancy between the indicated $TC-O_2$ values when delivered in 21% O_2, balance N_2O, and $TC-O_2$, varied less than 10 mmHg from the calculated PO_2 of the test gas mixture at all times.

Discussion: Clinically useful transcutaneous oxygen monitoring during general anesthesia requires that indicated TCO_2 values reflect tissue PO_2. Although careful attention to polarization voltages appears to have eliminated $TC-O_2$ artifact caused by N_2O, our data indicate that halothane interference can gives falsely high $TC-O_2$ readings even with Teflon PTFE membranes. These in vitro findings suggest that properly designed $TC-O_2$ systems may be used with confidence during general anesthesia with nitrous oxide, enflurane, or isoflurane. Sustained exposure to halothane in clinically-used concentrations at commonly encountered PO_2 values, however, may produce falsely elevated indicated $TC-O_2$ when either Teflon or polypropylene membranes are used.

Reference:

1. Rafferty et al.: In vitro evaluation of a transcutaneous CO_2 and O_2 monitor: The effects of nitrous oxide, enflurane, and halothane. Med. Instr. 15: 316,1981.

Figure: