Anesthesiology
V 57, No 3, Sept 1982

Title: SHOULD CAPNOMETRY REPLACE CAPNOGRAPHY IN PEDIATRIC ANESTHESIA?

Authors: W. S. Jordan, M.D., D. R. Westenskow, Ph.D., J. K. Hayes, M.S., L. S. Roberts, M.D.

Affiliation: Department of Anesthesiology, The University of Utah School of Medicine, Salt Lake City, Utah

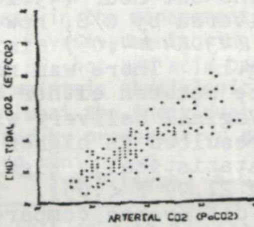
Introduction. Infra-red analysis of the exhaled carbon dioxide is not new. There has been a resurgence of interest in the past few years and development of instruments that display peak CO_2 in digital form. This is capnometry. Do we need the actual curve (or capnography) in daily anesthesia practice?

Method. Fifty patients ages 1-12 years were monitored with both the Siemens flow-through pediatric cuvette and the Puritan-Bennett side sampling instruments. Arterial blood gases were performed on the Radiometer ABL3 and transcutaneous CO_2 with Novametrix. The transutaneous gas monitoring was included in a subset of 34 patients.

Results. The most informative results are included in the recordings from the two IR analyzers which will be presented. Two of these are included here. The substudy of transcutaneous, arterial and end-tidal CO_2 had the statistical problem that each patient must be treated independently. Regression analysis was performed on a minimum of 5 data points collected simultaneously on each patient. Using a chi square test with a Fisher Z transformation, the hypothesis that the correlation coefficients between $PaCO_2$ and $TCPCO_2$ were similar in all patients could be accepted. The Null hypothesis had a $p=0.15$ $x^2= 42$ so it was unlikely that they were unrelated, with an average R value with n weighing of 0.91 and a 95% confidence interval of .87-.94. The relationship of $ETCO_2$ to $PaCO_2$ had a $X^2=115$ large enough that the distribution of data did not give a good central tendency. The Null hypothesis that there was not a similar mean correlation cofficient has a $P<10^{-6}$.

Discussion. The scattergram of $ETCO_2$ vs $PaCO_2$ illustrates a surprising wide scatter of data for a widely accepted technique. In pulmonary pathologic states end-tidal CO_2 is known to be inaccurate frequently. Sometimes this is due to failure to have an end tidal plateau; other times it is because of a changing arterial to end-tidal concentration gradient. This study included patients without known pulmonary disease. Figure I shows the normal CO_2 capnogram with good plateau and clear rise and rapid fall. Combining flow measurement (as Siemens does in their ventilator) effective ventilation for gas exchange can be approximated. In figure II, a common occurring recording shows varying respiratory volumes without a true plateau. The algorithm the instrument operates with will give a digital value for peak CO_2. Simultaneous values for $PaCO_2$, $ETCO_2$ and $TCPCO_2$ can obviously be misleading. The Siemens flow-thru cuvette has a more rapid response and the algorithm recognizes shorter time constants. It would show the cardiac wave superimposed on the descending CO_2 curve as another $ETCO_2$ value. The Puritan-Bennett instrument is limited by its sampling rate-maximum is 150 cc x min^{-1}. This rate will not be suitable for low flow anesthesia; to preserve heat and humidity practiced here. Slow sampling rates may not recognize end-tidal plateaus. At a respiratory rate of 40 and 150 cc sampling rate the end-tidal value was 0.6 vol % lower on the Puritan-Bennett than the Siemens due to no plateau occurring.

Summary. The end-tidal CO_2 monitoring was statistically less accurate in indicating the trend of $PaCO_2$ change than transcutaneous CO_2. The reason for this was the inaccuracies in capnometry. Capnography is required to verify proper recognition of alveolar air. The newly released Hewlett-Packard monitor, and the new Siemens physiologic monitor, which combine a flow-through cuvette with microprocessor storage of the digital CO_2 curve should be good instruments. Only the Siemens presently has a pediatric, low dead-space cuvette. Continuous printing of the curve on paper is obviously impractical. In the small pediatric patient with small volumes and high frequency, capnography and Pediatric cuvette are important.



Scattergram

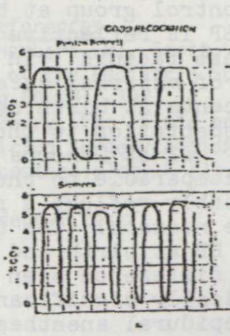


Figure 1
Normal Capnogram

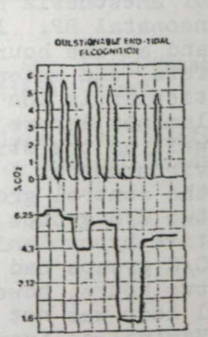


Figure 2
Common Capnogram

Downloaded from http://asa2.silverchair.com/anesthesiology/article-pdf/57/3/A419/630668/0000542-198209001-00419.pdf by guest on 03 April 2024