A Software System to Collect High-Resolution Respiratory Data for Analysis of Transient Airway Events During General Anesthesia

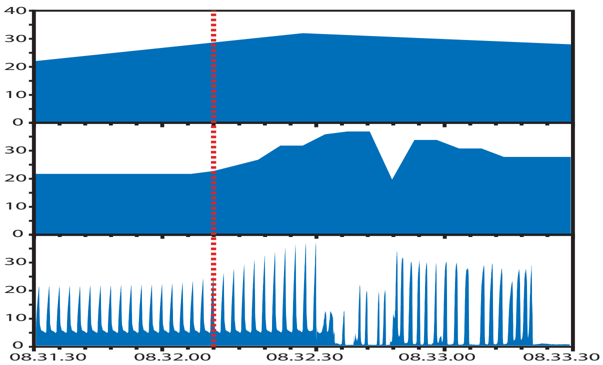
Authors: Ian Yuan, MD, MEng*; Robert Machnicki Jr., MD; Matthew Hirschfeld, MD; Anna Rabinowitz, MD; Michael J Williams, MD; Richard H Epstein, MD. Department of Anesthesiology, Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, PA. *Presenting author.

Introduction: Anesthesia information management systems (AIMS) typically record intraoperative data q 1 minute, with some allowing up to q 15 sec resolution. These intervals are inadequate for capturing transient changes in airway parameters, necessary in our ongoing study of bronchospasm in pediatric retinoblastoma patients undergoing ophthalmic artery intra-arterial chemotherapy (IAC). We describe the technical details of configuring such a system to capture airway parameters at much higher resolutions.

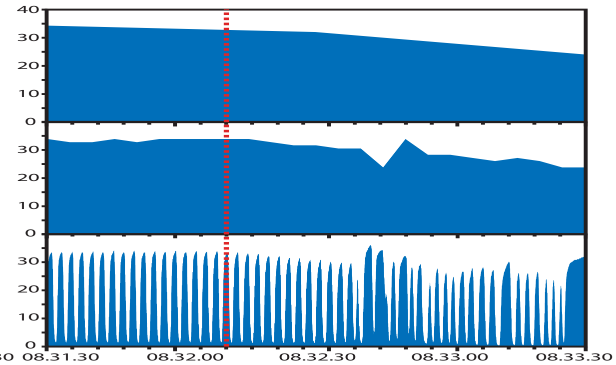
Methods: With IRB approval and written parental consent, intraoperative data of patients undergoing IAC were collected on a laptop PC. We used the Dräger Medibus® Data Acquisition Program (version 1.4.0.0, Dräger®, Telford, PA), available to their customers at no charge from Dräger® requiring Microsoft Windows XP®. A standard USB to DB-9 cable was used to connect to the COM 1 port on the Dräger Apollo® anesthesia machine.). The number assigned to the USB port used must match the port number in the collection software (1-4). Baud Rate = 9600, Parity = Even, Stop Bits = 1. The anesthesia machine COM port was similarly configured, as specified in the technical manual for the device. When settings are correct, the program header displays "Connected to: Apollo" and waveform data are displayed. The following data can be plotted q 16 msecs: peak pressure (mbar), flow (l/min), and $etCO_2$ (mmHg) and can be saved to disk ("Curve Recording" mode) as a text file. Alternatively, the following data can be saved q 5 seconds ("Data Recording" mode): compliance [ml/mbar], peak breathing pressure [mbar], PEEP [mbar], plateau pressure [mbar], tidal volume [ml], and etCO2 [mmHg]. Files from Curve Recording and Data Recording were imported into Microsoft Excel® for signal processing and analysis.

Results: In a retinoblastoma patient who developed bronchospasm, figure 2 shows peak pressure and figure 3 shows etCO2 recorded with different resolutions over a two-minute window. The top graphs shows Dräger Innovian® AIMS recordings of every minute, middle graphs shows recordings of every 5 seconds, and the bottom graphs shows high-resolution recordings of every 16 msecs. The red dotted line indicates the time (08:32:10) when the catheter entered the ophthalmic artery. Compared to our AIMS data, where changes in peak pressure are noted 1 minute after the catheter entered the ophthalmic artery, the high-resolution data is marked by increases in peak pressure occurring within 5 seconds (middle graph) and 0.2 seconds (bottom graph) of the triggering event.

Conclusion: Although commercially available AIMS, with its longer recording intervals may be sufficient for clinical practice, this is inadequate for research purposes, especially where transient phenomenons need to be analyzed. For researchers using Dräger anesthesia machines, the data acquisition software describes provides a convenient method to collect high-resolution data sufficient for signal processing.



(Figure 2) Peak Pressure (mBar) vs Time



(Figure 3) etCO2 (mmHg) vs Time