Using Automated End-Tidal Control in Routine Clinical Practice Influences Fresh Gas Flow Rates and Demonstrates Inhalational Kinetics

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Background: We have a long standing interest in the kinetics of volatile anaesthetics and consequently in encouraging low fresh gas flow rates (1,2). This meant that when replacing our anaesthetic machines, systems with automated control of end-tidal agent concentration were appealing. In 2010-2011 we installed 27 GE-Aisys with end-tidal control (ETc). At that time this was the only machine with automated vapour control available in New Zealand. There is an increasing body of evidence that these devices reduce volatile consumption and workload (3,4).

Some anesthesiologists felt trainees would not learn volatile uptake and kinetics from these machines. It is our impression that watching how the automated system performs in various situations actually demonstrates theory well and that the uptake changes seen may provide useful information.

The aims of this poster are a) to update our fresh gas flow rate experience and b) provide illustrations of how observing an automated controller demonstrates volatile kinetics.

Method: Appropriate Ethics Committee approvals and written consents were obtained.

We have described our methodology for collecting fresh gas flows from anaesthetic machines (4). In summary we collect flow rate and vaporizer dial settings from individual machines over several weeks. We then extract the fresh gas flow rate at times when vapor is being delivered and then derive mean FGF and the distribution of times at different flow rates for each sample and the pooled data. Previously collected flow rate data much of which has been published previously was used for comparison.

Data was also collected from patients undergoing off-pump cardiac surgery. The end-tidal sevoflurane target was kept constant for up to 90 minutes. The changes in inspired and expired sevoflurane and ETCO2 around the time of cardiac manipulation were extracted.

Results: Just prior to introduction of Aisys mean FGF was 1.26 l/min. In our latest sample (Aug 2014) mean FGF is 0.83 l/min. We saw an initial increase in overall FGF followed by a decrease over time as usage of ETc increased from 35% in 2010 to 85% in 2014.

The cardiac surgical cases show Fi-sevo decreasing 3-4%/hr while end-tidal remains constant, illustrating decreasing uptake with time. With cardiac manipulation we observe abrupt changes in Fi-sevo which parallel but are greater than changes in ET-CO2.

Discussion: Introduction of machines with automated agent control has reduced our already low mean fresh gas flows by 1/3 representing a saving of $50,000 pa or around $2,000 per location per annum. In addition these machines clearly demonstrate inhalational kinetics and the effects of physiological changes on agent uptake. The changes in Fi-agent produced by the controller in response to changes in patient physiology may provide the basis for additional monitoring tools.

References

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