Automated End Tidal Control Device Achieves and Maintains Concentration of Exhaled Agent and Oxygen Effectively

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Background

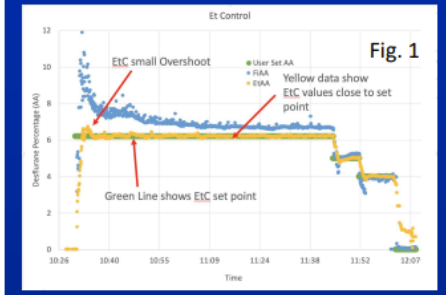
- Automated gas control is a novel method that alters Fresh Gas Flow (FGF) and controls end tidal agent and oxygen using an End Tidal Control (EtC) device, see Screenshot.
- EtC is proprietary software installed on the GE Aisys CS2 anesthesia machine (GE Healthcare, Madison WI).
- The user selects desired end tidal anesthesia agent (EtAA) and end tidal oxygen (EtO_2) concentrations. EtAA / EtO_2 measured every breath.
- The EtC software algorithm adjusts mixer (FGF) and vaporizer output to achieve and maintain target values, then FGF is automatically reduced to minimal flow when using EtC, to 0.5 L/min

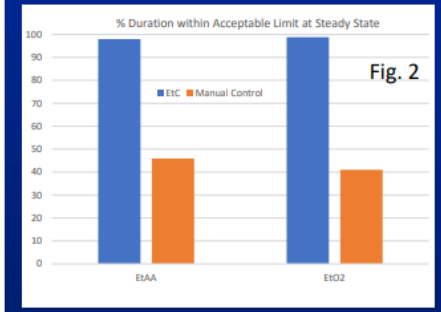
Methods

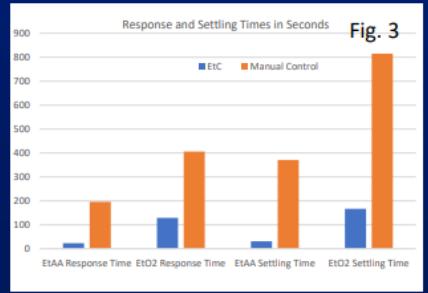
- A prospective RCT of 220 patients ≥ 18 y, ASA PS 1-3, assigned to Manual Control (MC) or to use EtC to alter FGF and agent / oxygen concentrations automatically. Non-cardiac cases were studied.
- MC arm used standard manual control of FGF or agent / oxygen, and providers recorded their intended set points.
- EtC arm set the desired EtAA and minimal flow on the Aisys and the EtC software then altered FGF and concentrations.
- Gas data extracted from the Aisys internal log.

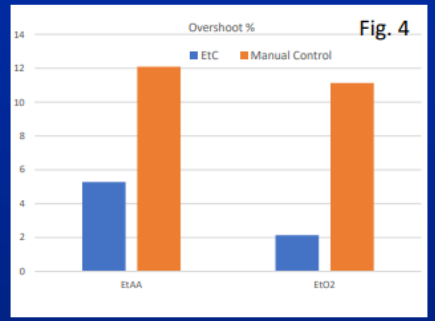
- Primary objective; EtC achieves and maintains EtAA and EtO_2 in a manner that is non-inferior to MC by a margin of 5%.
- Secondary objectives; safety data for EtC arm, amount of agent used in each arm, number of user interactions.

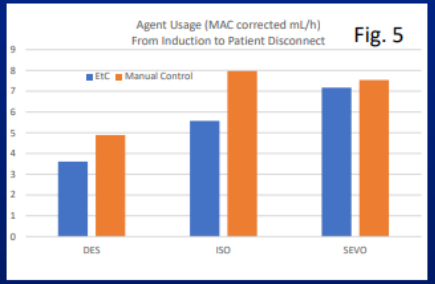
- Performance of EtC examined **percentage of time** with agent or oxygen within acceptable concentrations (the greater of ± 5% from steady state mean concentration (SSMC) set); **efficacy**, response time to reach 90% of the desired SSMC; **settling time**, time to achieve the desired EtAA and EtO2 SSMC; **overshoot**, amount the EtAA and EtO2 deviated temporarily from final SSMC.











Results:

- Fig. 1 shows a case example of close matching of EtC to desired concentrations. Subsequent figures show means values.
- No significant difference was found in study population ages, adverse events, user interactions or vasoactive drug use.
- Accuracy was high for EtC which maintained concentrations within 0.1% DES, 0.03% ISO, 0.04% SEV. EtAA was within acceptable limits for 98% using EtC and EtO2 98.8% of the time, but MC only 45.9% and 41% respectively, see Fig. 2.
- Fig. 3 shows response time and settling time in seconds. Fig. 4 shows the limited overshoot using EtC.
- EtC superiority was highly significant at p<0.001 (except for agent usage) in all domains.
- Mean inhaled agent usage was reduced by 26% for DES, 30% ISO, 5% SEVO; Sevo savings were small as minimal flow was set at 2L/min to avoid Compound A issues, others used 0.5L/min. See Fig. 5
- 99% of staff rated ease of use of EtC same or easier than MC, most rated EtC Purge during emergence as same (30.1%) or easier (64.1%) than MC.

Conclusions:

- EtC is safe and effective in achieving the desired EtAA and EtO_2 concentrations.
- EtC rapidly attains set levels.
- EtC maintained the end tidal level within a closer tolerance with minimal overshoot than standard anesthesia practice.
- A large majority of staff found EtC easy to use.

EtC GE Aisys Screenshot

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