Illustrating volatile kinetics using changes in F_I during end-tidal control.

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Background

Uptake of volatile anaesthetic agents is well described

Cardiac output (Q) is a major factor

At equilibrium uptake from lung = delivery

$\therefore$ Fi-Fe is uptake (assuming constant ventilation)

Measure $\triangle$uptake by balancing totally closed circuit

Or accurately measure delivery

$\triangle ET\text{-}CO_2$ recognised as marker of $\triangle Q$

advocated as tool in OPCAB

We have explored $\triangle$ET-agent and $\triangle Q$,

found $\triangle ET\text{-}CO_2 > \triangle$ET-agent

Aisys (GE) controls ET-agent,

what can we learn from how it does this?

Objective

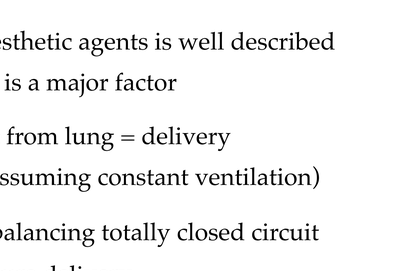
What can we learn from changes in Fi over time with a constant ET target?

Figure 1: The effect of abrupt cardiac output change on $ET\text{-}CO_2$ and ET-agent.

Perturbation commenced at

Treatment commenced at

(from Kennedy et al AIC 2001)

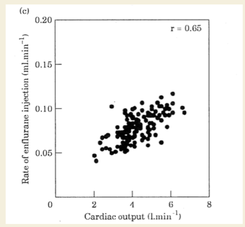


Vagal bradycardia

Rapid blood loss

Figure 2: Relationship between rate of enflurane injection to maintain ET-enflurane of 1% and cardiac output.

(from Watt et al BJA 1996)



Method

Ethical approval & patient consent.

OPCAB: lifting (& restoring) heart ⇒ large $\triangle Q$

ET-sevo target chosen by anaesthetist & not changed

propofol / pressors to control SE / MAP

Download "ETc logs", to extract data

(FloTrac/Vigileo for CI estimate & record MAP)

Results (exploratory!)

Clear decrease in Fi over time (= decrease in uptake)

Slope is 3-4%/hr (≈ 8-10%/hr fall in uptake)

Distinct parallel movement in $ET\text{-}CO_2$ & Fi-sevo

$\triangle$Fi agent > $\triangle$ETCO2

opposite of effect on $\triangle ET\text{-}CO_2$ with constant Fi

Collected Vigileo/Flowtrak data as marker of CI

(known to be problematic!)

$\triangle$CI seem unrelated to $\triangle ET\text{-}CO_2$

Some association of MAP and $\triangle ET\text{-}CO_2$

But anaesthetists manage MAP….

Discussion

Changes in Fi illustrate changes in uptake, can enhance understanding of kinetics

$\triangle$Fi agent is a stronger signal of $\triangle Q$ than $\triangle ET\text{-}CO_2$ in contrast to $\triangle$ET agent with constant Fi

Need better measures of $\triangle Q$!

Figure 3: Decreasing Fi-sevo with constant ET target over 40 min

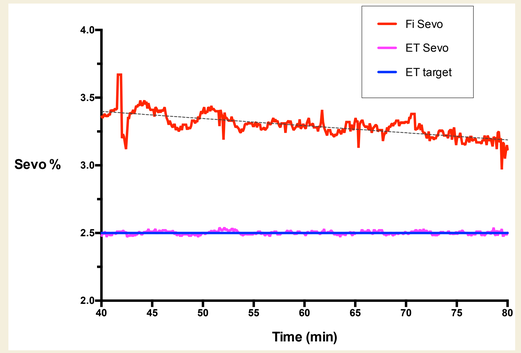


Figure 4: Constant ET target during OPCAB. Obvious changes in ET-sevo and $ET\text{-}CO_2$ with cardiac manipulation

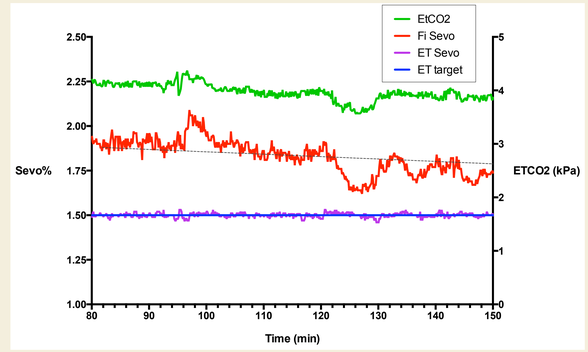
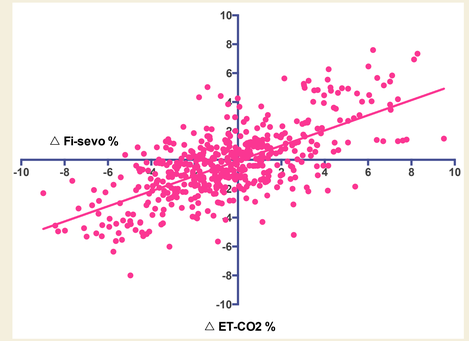


Figure 5: $\triangle$ET-sevo vs $\triangle ET\text{-}CO_2$ over the period in Fig 4. Slope of line = 0.52, R^2=0.45



References:

1. Kennedy RR, Baker AB. Br J Anaesth. 1993;71:398.
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3. Watt SJ, et al. Anaesthesia. 1996;51:24.
4. Isserles SA, Breen PH. Anesth Analg. 1991;73:808.