[OS2-99] Evaluation of activated charcoal filters in pediatric ventilator settings on two different anesthesia machines

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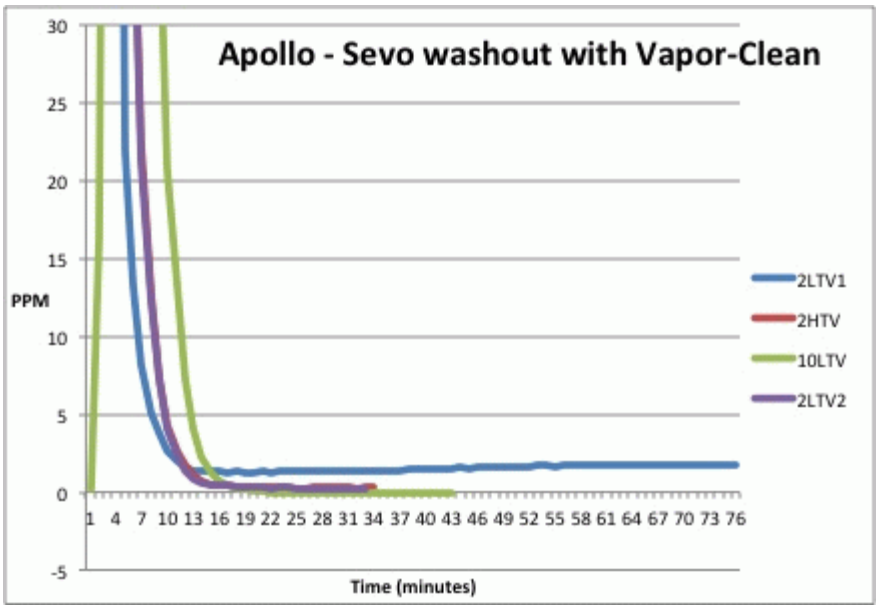
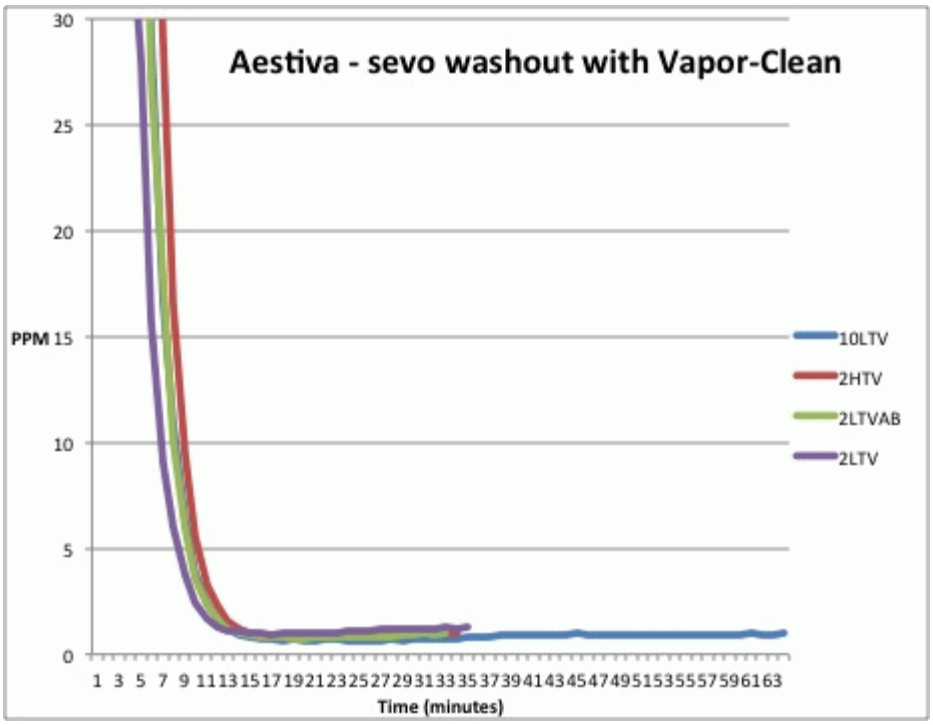
Background
With the evolution of newer anesthesia machines incorporating more plastic and rubber components into their internal breathing systems which act as a volatile anesthetic sink, recent studies show that the concentration of volatile anesthetic in anesthesia machines can remain well above the 5ppm threshold after a flush far longer than the previous 20 or 30-minute standard.
MHAUS advocates the use of commercially available activated charcoal filters as one option to provide vapor free anesthesia machine for MH susceptible patients.
These filters have been well studied using adult ventilator settings1. The fresh gas de-coupling mechanism of the newer anesthesia machines makes it possible for different tidal volumes may have different effects on wash-out from the internal breathing components of these machines2.
We setout to test the two different makes of anesthesia machines in use at Stanford University Hospitals with a goal to evaluate the effectiveness of these charcoal filters at different ventilator settings using neonatal and pediatric tidal volumes.
Study design
We first contaminated the Drager Apollo machine to deliver 7% Sevoflurane to a test lung for 90 minutes. Then we turned–off the vaporizers, replaced the breathing circuit, rebreathing bag, test lung and CO2 absorbent. Per Vapor-Clean manufacturer's recommendation, we flushed the machine at 10 LPM with a TV of 500 ml at 15 bpm for 90 secs. The charcoal filters (Vapor-Clean, Dynasthetics, Salt Lake City, Utah) were then placed both on inspiratory and expiratory limbs of the circuit. We measured the concentrations of sevoflurane in the inspiratory limb between the breathing circuit and the test lung every 30 seconds until the values reached below 5 ppm, using the Miran SapphIRe XL Gas Analyzer (Thermo-Fisher Scientific, Waltham, MA)). This was repeated for lower and higher tidal volume ventilations and for lower and higher fresh gas flow rates.
Then we repeated the entire experiment on the Datex Aestiva machine.
Results
It is encouraging to note from the attached graphs that, with the modern anesthesia machines even with varying ventilator settings, the charcoal filters are effective in reducing the vapor concentrations well below the safe levels within minutes.

References:

1.Birgenheier N, Stoker R, Westenskow D, Orr J. Activated charcoal effectively removes inhaled anesthetics from modern anesthesia machines. Anesth Analg. 2011 Jun;112(6):1363-70.

2.Gunter JB, Ball J, Than-Win S. Preparation of the Dräger Fabius anesthesia machine for the malignant-hyperthermia susceptible patient. Anesth Analg. 2008 Dec;107(6):1936-45


Apollo - Sevo washout with Vapor-Clean
PPM
Time (minutes)
2LTV1
2HTV
10LTV
2LTV2


Aestiva - sevo washout with Vapor-Clean
PPM
Time (minutes)
10LTV
2HTV
2LTVAB
2LTV