DARVALL Stingray™ Circle Absorber

Universal Low-Flow Anesthesia System for Animals 5lb to 175lb

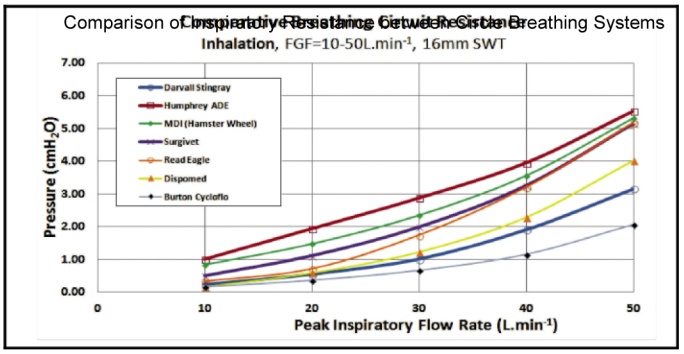
Over 80% of anesthetised animals are smaller than 35lb and traditionally a variety of non-rebreathing circuits have been used, particularly for animals below 20lb. Resistance, dead space, rebreathing of CO_2, slow response and unpredictable inhalation anesthetic concentrations are all suggested as reasons for not using circle systems. However non-rebreathing systems require high flows (up to 20 x that of efficient circle systems) of cold, dry gas which contributes to hypothermia, cost and increases environmental WAG pollution.

Design, sizing and placement of components including valves, hoses and connecting passages can affect resistance, circuit volume and speed of response to changes in delivered inhalation anesthetic. A novel circle breathing system, the Darvall Stingray™ has been developed with the goal of overcoming the limitations of using circle systems in animals as small as 5lb.This circle system was tested for resistance and rate of change of anesthetic concentration against other commonly used circle systems. [1-3]

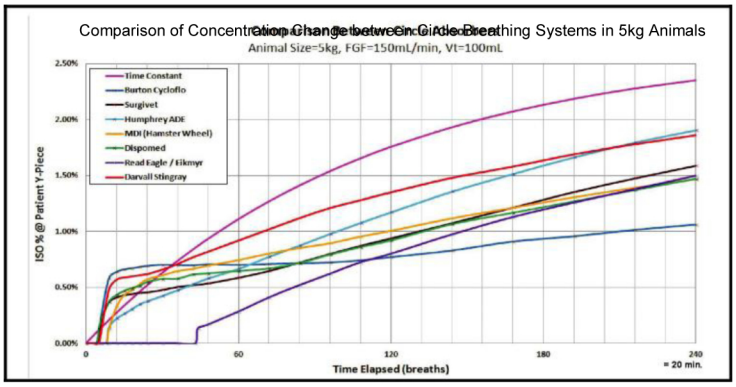
Resistance to gas flow

In this study we compared resistance of the Darvall Stingray™, designed to minimize resistance and maximize speed of response, against some commonly available CBS's used in veterinary anesthesia (see graph 1).[1] We found that:

1. Resistance increases with flow and for inspiration is generally higher than expiration
2. Resistance varies between and within CBS's
3. The Humphrey ADE has very high expiratory resistance, exceeding 5 cmH_2O at 40 L/min
4. The Darvall Stingray™ was the only circuit with inspiratory and expiratory resistance < 2 cmH_2O at flows up to 40L/min.



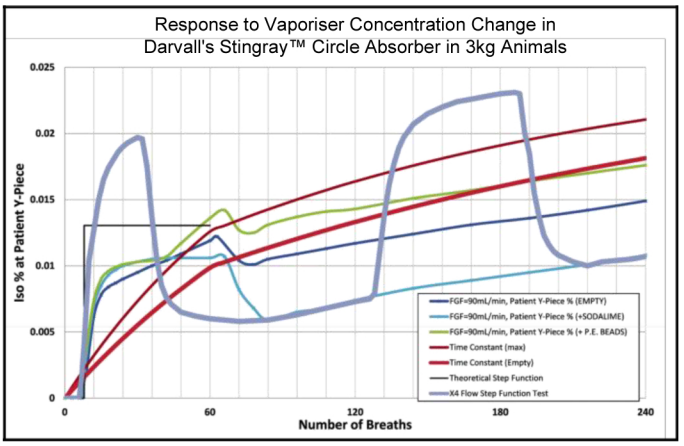
Graph 1: Resistance to air flow through the inspiratory limbs of circle systems using Darvall 5/8" 5' long Smooth Wall Anaesthesia Hose with air flows of 10, 20, 30, 40 and 50 L/min (peak flows for approximately 30, 65, 110, 140 and 175lb dogs).The Darvall Stingray™ Circle Absorber (AAS) compared to the Humphrey ADE (ADE); MDI Hamster Wheel (MD); Read Eagle/Eikenmeyer (RE) and Surgivet (SG) circle systems. Inspiratory resistance increased with flow and was generally higher than expiratory resistance but was lowest for the AAS then RE, SG, MD, with ADE highest.[1,2]



Graph 2: Comparison of the rate of change of isoflurane concentration (ISO) between a novel circle system - the Darvall Stingray™ Circle Absorber and the Burton's Cycloflo; Humphrey-ADE; Medical Developments hamster-wheel ; Read Eagle/Eikenmeyer and Surgivet circle systems. Experiment based on a 12lb animal model using a fresh gas flow of 70 ml/lb/min; 12 breaths/min at a Tidal Volume of 100 ml.All systems used Darvall 1/2" ID smooth wall hoses, a 500 ml rebreathing bag and CO_2 absorber canisters were filled with 3/16" OD polyethylene beads representing soda lime volume. Magenta Line = predicted change based on time constant. The Darvall Stingray™ concentration rises rapidly in the first 30 breaths (2.5 min) and the concentration rises faster in the first 20 minutes compared to other circle systems. [2]

Rate of Rise in Anesthetic Concentration

In this study we compared the rate of change of isoflurane concentration in the same circle systems (see graph 2).[3] We found that the response of Darvall Stingray™, Burton's Cycloflo, Surgivet and MDI Hamster wheel responded more rapidly than the model predicted (at 6.5, 11, 22 & 45lb taking 12-18 breaths before change in the fresh gas concentration was first detected at the Y-piece) and the Humphrey ADE and Read Eagle (Eikenmeyer) were slower (60 and 24 breaths respectively).



Graph 3: Darvall Stingray™ Circle Absorber used on 6.5lb animal model at gas flows down to 15 ml/lb/min with 12 breaths/min at a Tidal Volume of 60 ml shows a lightening fast response to vaporizer dial changes. Red Line = predicted change based on time constant.[3]

Response to Vaporizer Change

The dynamic response of circle systems to changing vaporizer concentrations varies widely between CBS's but can be optimized by novel design and sizing.The Darvall Stingray™ has a unique gas accumulation and delivery system that enables very rapid response to changes in vaporiser settings, even in very small animals with gas flows as low as 100 ml/min. (see graph 3).[3]
The Darvall Stingray™ is designed to give predictable anesthesia with very rapid response to changes in vaporizer settings for animals from 5lb to 175lb at 30ml/kg/min O_2 flows, providing a universal standardised breathing system solution that saves money, environmental WAG pollution, reduces hypothermia and standardises equipment in anesthesia.

References

1. T Wallis, CI Dunlop, JS Dunlop et al. A model for analysis of flow resistance in a circle system designed for small animals to 2kg. Abst.WCVA, Capetown S. Africa Sept 2012
2. JS Dunlop, CI Dunlop, P Hartigan et al. Comparative Flow Resistance of Circle Breathing Systems used for Anaesthesia of Small Animals. Abst. WCVA, Capetown S. Africa Sept 2012
3. CI Dunlop, JS Dunlop, RA Curtis et al. Comparison of the dynamic response to changing anaesthetic concentration in circle breathing systems used on animals from 3 to 20Kg. Abst.WCVA, Capetown S. Africa Sept 2012