Memsorb^{tm}, A Novel Co_2 Removal Device
Part I: In Vitro Performance With The Zeus Ie®

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Introduction: Soda lime-based CO_2 absorbents are safe, but not ideal for reasons of ecology, economy, and dust formation. These drawbacks are absent in the Memsorb^{TM}, a new CO_2 removal device that uses cardiopulmonary bypass oxygenator technology: a sweep gas passing through semipermeable hollow fibers adding or removing gases from the circle breathing system. We studied the in vitro performance of a prototype Memsorb$^{™}$ with a Zeus IE® anesthesia machine when delivering sevoflurane and desflurane in O_2/air mixtures.

Methods: The Memsorb is attached to the Zeus IE® in place of the conventional CO_2 absorber. An O_2/air blender was connected to the Memsorb$^{™}$. A 2 L breathing bag was ventilated via a circle breathing system simulating the lung. CO_2 production (VCO_2) was simulated by feeding the breathing bag with 160 mL/min of CO_2 (Fig.1) with the following ventilatory settings: controlled mechanical ventilation, tidal volume 500 mL, respiratory rate 10/min, I:E ratio 1:1, and 5 cm H_2O PEEP. A set of seven experiments were done by altering the ventilatory settings to determine the effect of the Memsorb on kinetics of CO_2, O_2, and volatile anesthetic.

Results: CO_2 kinetics: F_ICO_2 is inversely related to the sweep flow, and proportional to the fresh gas flow (FGF). The relation between VCO_2 and sweep flow to maintain $F_ICO_2 \leq 0.5\%$ is proportional. Lowering respiratory rate while maintain MV seems to improve the CO_2 removal. O_2 kinetics: matching the O_2 concentration of the FGF and sweep flow ensures F_IO_2 will be the same. Volatile anesthetics kinetics: while using target control on the Zeus, agent usage per % end-expired agent increases with increasing agent target concentration and F_IO_2. Desflurane usage during target control is higher with Memsorb than with Dragersorb 800+.

Conclusion: The Memsorb offers an environmentally friendly solution. Yet, the complexity of the kinetics, although predictable, can limits its use in daily practice. The Memsorb CO2

removal capacity seems to be challenged with higher MV, VCO_2 > 250 mL/min and lower FGF. Such device needs to be incorporated in the anesthesia machine with an automated function.