LOW, MINIMAL AND METABOLIC ANESTHESIA USING A NOVEL MEMBRANE TECHNOLOGY INSTEAD OF CHEMICAL ABSORBENTS FOR CARBON DIOXIDE REMOVAL – CLINICAL DATA

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Background

Lowering fresh gas flow (FGF) rates in anesthesia circuits reduces the gas volumes vented to the environment. This effort is rapidly gaining importance due to increasing pressure to (a) save cost and (b) decrease the environmental footprint of anesthesia practice, both achievable by lowering FGFs.

While low-flow (≤1.0 Lpm), minimal-flow (≤0. 5 Lpm), and metabolic-flow (≤0.35 Lpm) anesthesia practices have long been technically feasible using chemical absorbents, membrane technology promises a host of advantages including improved simplicity, reliability, safety, environmental stewardship and cost. In addition, membrane technology eliminates the concerns that have resulted in vapor manufacturers' recommended minimum FGF rates of 1-2 Lpm (country dependent). Last but not least, membrane technology has the ability to automatically satisfy the metabolic oxygen need of any patient simply based on concentration gradient-mediated transmembrane gas transport, eliminating the need for a FGF to maintain a target FiO_2.

Objective

This study aims to investigate the safety and feasibility of using a membrane technology-based product, (memsorb™, DMF Medical Inc., Halifax, NS, Canada) instead of chemical absorbers under *low-flow*, *minimal-flow,* and *metabolic-flow* conditions for carbon dioxide removal. memsorb™ is designed to function continuously over 10-12 months, significantly reducing (i) absorber waste (ca. 300 absorbers/ year), (ii) carbon footprint from absorber transportation, (iii) cost of storage and disposal, and (iv) safety concerns associated with eliminating dust and other chemical reactions with absorber use and disposal.

Methods

After REB approval at Dalhousie University (Halifax, Canada), McGill University (Montreal, Canada) and OLV Hospital (Aalst, Belgium) memsorb™ was tested in 129 patients replacing the chemical absorber on Fabius® machines (Dräger, Lübeck, Germany) while standard general anesthesia was practiced using vapors and with their personal choice of Fresh Gas Flows. The flush gas for memsorb™ was set to 15 Lpm and its Air:O_2 ratio was adapted to match the target oxygen concentration of the anaesthesia system. Cases with FGF ≤ 1.0 Lpm were selected and divided into low, minimal, and metabolic FGF groups. Vapor consumption was determined using photo-volumetric analysis of the fill degree on the vaporizer.

After REB approval, a second study analyzed 63,318 cases at Nova Scotia Health Authority (Halifax, Nova Scotia, Canada) from 2014 to 2016 for the case mean FGF to describe a status quo for comparison.

Results

The mean (±SD) FGF of all 63,318 cases from 2014 to 2016 was 2.8±1.7 Lpm. 94% of cases used a mean FGF rate of ≥1.0 Lpm and 62% used a mean of ≥2.0 Lpm.

During the memsorb™ study it was shown that the $EtCO_2$ value for each FGF group divided into sevoflurane and desflurane cases were within safe range (Table 1).

Using minimal or metabolic flow with memsorb in comparison to standard practice with chemical absorbers, resulted in a 57% reduction for Sevoflurane and 63% reduction for Desflurane consumption during this study.

Conclusions

memsorb™ showed physiologically safe $EtCO_2$ data under all studied conditions. This confirms that memsorb™ provides a safe and valid alternative to chemical-based absorbents, while also reducing the environmental impact of CO_2 removal.

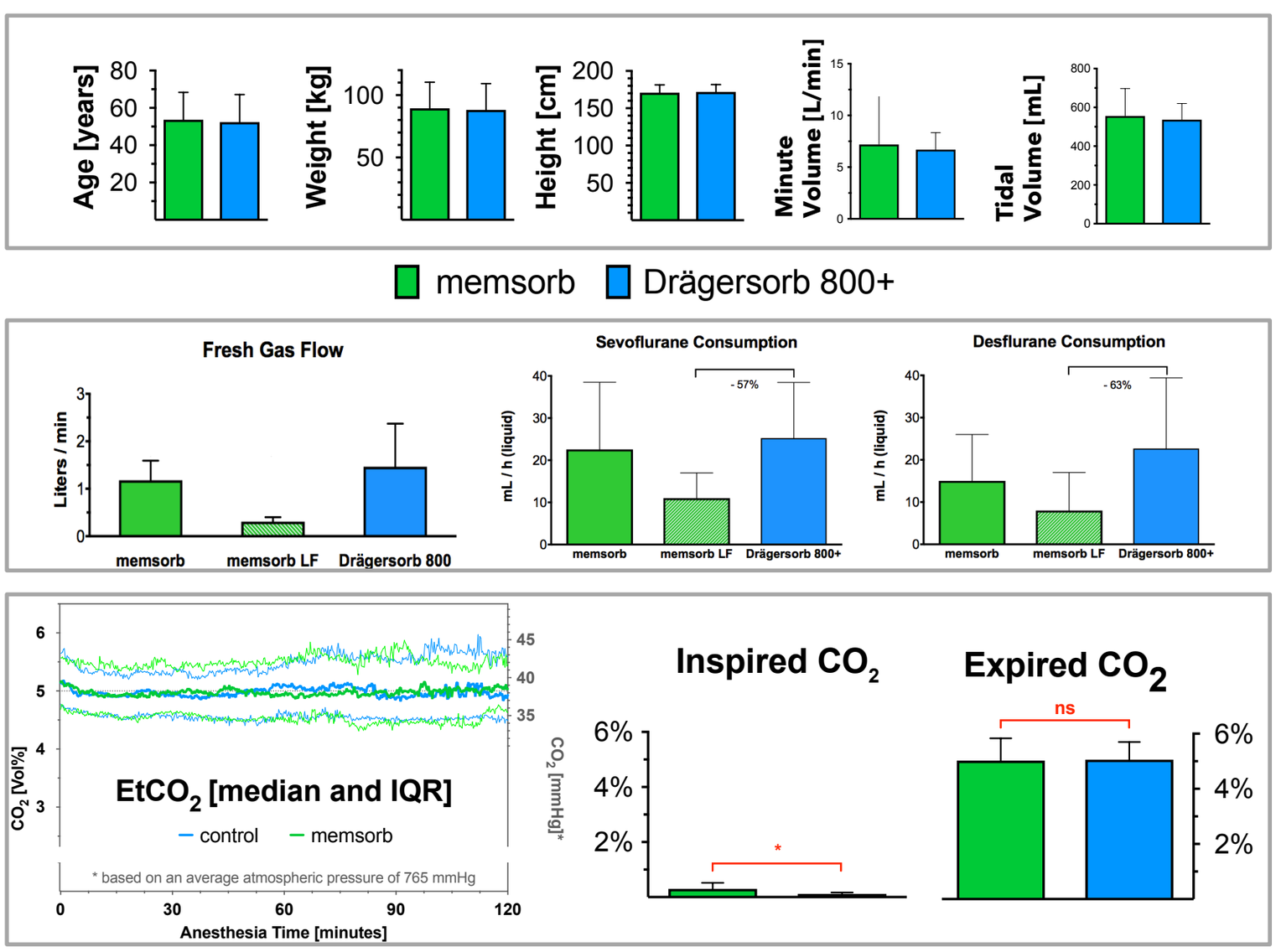

Table 1: $EtCO_2$ data for memsorb

FGF Group		FGF [median (SD)]	Agent	N	$EtCO_2$ [median (SD)]
Low	≤ 1.0 Lpm	0.78 (0.14) Lpm	Sevo	24	4.89 (0.46)
			Des	12	4.96 (0.47)
Minimal	≤ 0.5 Lpm	0.43 (0.05) Lpm	Sevo	8	5.13 (0.46)
			Des	8	5.44 (0.32)
Metabolic	≤ 0.35 Lpm	0.21 (0.05) Lpm	Sevo	9	5.83 (0.18)
			Des	8	5.12 (0.52)

Conflict Of Interest

Dr. Schmidt is the Founder, Chief Medical Officer and major shareholder for DMF Medical. Dr. Roach is the President and major shareholder of DMF Medical. Dr. Wilfart is a Director and shareholder of DMF Medical. Mr. Ford reports personal fees from DMF Medical. Dr. Orlando Hung has independently run this study and recorded the data as principal investigator and reports no conflict of interest.

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