Effect of the State of Hydration of Carbon Dioxide (CO_2) Absorbent upon Weight Changes of Canisters

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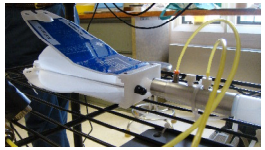
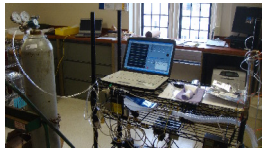
Introduction

CO_2 absorbents have a chemical composition that is a hydroxide, typically Ca, Na or K. Lithium hydroxide was previously noted to produce a marked exothermic reaction precluding clinical use. Absorbents have nominal water content between 9 - 14%. When the water content is removed the desiccated absorbent may interact with volatile agents to produce unwanted compounds e.g. desflurane and CO. ExtendAir®Lithium is a novel lithium hydroxide absorbent wherein the lithium is pre-hydrated to form lithium monohydrate. We hypothesized that ExtendAir®Lithium would show similar changes in weight irrespective of hydration state during exposure to volatile agents. We tested this hypothesis by comparing the canister weight changes of three different carbon dioxide absorbents when exposed to three different volatile anesthetic agents.

Methods

A test breathing system was constructed using a Datex-Ohmeda Aestiva/5 anesthesia machine and a circle breathing circuit attached to a Linear Test Lung (Ingmar Medical). Ventilation was maintained at a tidal volume of 600 mL with a rate of 12 breaths/min. CO_2 was added to the circuit at a flow rate of 200 mL/min. In separate experiments, vaporizers were set to deliver either desflurane 9%, isoflurane 3%, or sevoflurane 8%. The fresh gas flow (FGF) remained at 3 L/min for both 20 min wash-in phases, but was increased to 10 L/min during the wash-out phase (30 to 40 mins). Three absorbents were studied: Amsorb® Plus, Medisorb® and ExtendAir®Lithium. Absorbents were considered either fresh (unopened manufacturer's packaging) or desiccated (sealed in foil bags following 72 hours exposure to constant gas flow), and were taken out of the packaging or foil bag immediately prior to insertion into the anesthesia machine canisters. A new breathing circuit was used for each experiment. The weight was measured using a Scout Pro 4000 x 0.1g scale & recorded at baseline immediately prior to and after completion of the experiment.





Results

Weight changes from baseline are shown in table 1. The upper canisters showed greater weight changes than the lower canisters. Given the different target volatile agent concentrations, the results are interpreted across absorbents for each volatile agent. For desflurane, the combined (weight changes for upper & lower canisters) were similar for all absorbents, with the desiccated absorbent showing greater changes than the corresponding fresh absorbent. For isoflurane and sevoflurane, the desiccated Amsorb® Plus & Medisorb® absorbents showed much higher combined weight changes than the fresh absorbents. In contrast, the combined weight change of the ExtendAir®Lithium was similar for both desiccated and fresh absorbents. The overall difference (total weight desiccated minus total weight fresh) was least with ExtendAir®Lithium and most with Amsorb® Plus.

		Amsorb® Plus		ExtendAir®Lithium		Medisorb®	
		Fresh	Desiccated	Fresh	Desiccated	Fresh	Desiccated
Desflurane	Upper	9.5	10.8	10.7	11.5	10.2	10.9
	Lower	0.4	2	1.2	0.8	0.3	0.9
	Combined	9.9	12.8	11.9	12.3	10.5	11.8
Isoflurane	Upper	9.6	13.6	11.7	11.6	9.7	10.7
	Lower	0.4	3.8	0.9	0.9	0.2	2.1
	Combined	10	17.4	12.6	12.5	9.9	12.8
Sevoflurane	Upper	8.9	12.6	11.2	11	9.4	12.2
	Lower	0	3.8	0.7	0.9	0.6	2.3
	Combined	8.9	16.4	11.9	11.9	10	14.5

	Difference in Weight (Desiccated – Fresh)		
	Amsorb® Plus	ExtendAir®Lithium	Medisorb®
Desflurane	2.9	0.4	1.3
Isoflurane	7.4	-0.1	2.9
Sevoflurane	7.5	0	4.5

Conclusions

Of the three CO_2 absorbents tested, ExtendAir®Lithium showed the least difference in weight change of upper and lower canisters when fresh and desiccated absorbents were compared. This suggests that both forms of the hydrated absorbent perform similarly.