Overdistention of the Rebreathing Bag, A Hazardous Test for Circle-system Integrity

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Good anesthetic practice demands that an anesthesia circle absorber system be checked for leaks and proper valve function prior to use. One method of testing involves occluding the face-mask outlet, closing the pop-off valve, and filling the circuit with oxygen from the flush valve. An intact circuit will distend the rebreathing bag and maintain a constant reading on a pressure manometer. Recently we observed a cloud of white particulate matter coming from the face mask when the occluding thumb was released after this testing maneuver (fig. 1). Dismantling the carbon dioxide absorber revealed the source of the material to be soda lime that had been shaken loose and had fallen through the fine-mesh base onto the floor of the canister. When the rebreathing bag was deflated, the rapid flow of gas through the canister carried the soda lime particles out of the absorber, deposited them in the inspiratory limb of the circle, and forced some out through the face mask. We undertook to determine the quantity of soda lime remaining in the inspiratory tubing after this testing maneuver.

FIG. 1. Flash photograph taken just as the anesthetist's thumb is released from the mask orifice with the rebreathing bag distended to 40 cm H_2O pressure. Copious amounts of soda lime dust are blown out as the rebreathing bag deflates.

MATERIALS AND METHODS

Inspiratory limbs of commercially available disposable anesthesia circuits† were weighed on a Mettler‡ analytical scale. One gram of finely ground soda lime particles was scattered on the base of a clean Quantiflex§ CO_2 absorber, the canister was reassembled, and the disposable tubing and rebreathing bag were connected to the machine with the tubing held horizontally. The rebreathing bag was allowed to deflate rapidly, as described above, from inflation pressures of 10, 20, 30, and 40 cm H_2O. After each deflation, the inspiratory limbs of the circles were reweighed to determine the amount of deposited soda lime. Following each determination, the canister was cleaned and a fresh gram of soda lime was placed on its base. This procedure was performed twice at each pressure reading.

RESULTS

The results are summarized in table 1. At 10 cm H_2O a minimal flow of gas was created and only 3 mg soda lime entered the inspiratory tubing. At 20 cm H_2O, there was considerably more flow, but only 10 mg soda

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TABLE I. Soda Lime in the Inspiratory Limb Tubing after Deflating an Over-distended Rebreathing Bag*

Circle System Pressure (cm H_2O)	Quantity of Soda Lime (mg)
10	3
20	10
30	46
40	181

* One gram of loose soda lime was placed in the CO_2 absorber. Mean of two determinations.

lime were measured in the tubing. At 30 cm H_2O, a rapid flow of gas that caused 46 mg soda lime to lodge in the inspiratory hose was created. Distending the rebreathing bag to 40 cm H_2O resulted in an explosive rush of gas and soda lime particles, depositing 181 mg CO_2 absorbent in the inspiratory limb. It was not possible to distend the rebreathing bag to more than 42 cm H_2O pressure.

DISCUSSION

Soda lime dust and particles accumulate in the base of the CO_2 absorber as a result of the vibrations inherent in wheeling anesthesia machines around the operating suites. Approximately a gram of this material is routinely found deposited in our canisters after a week's use. No amount of careful packing is able to remove all the dust particles from the canister. A considerable quantity of this material can be deposited in the inspiratory limb of the circle system when the overdistended rebreathing bag test is employed. This dislodged soda lime constitutes a considerable hazard for a patient, who may have this noxious material blown onto the face or into the airway.

Some anesthesia circles can be arranged so that the rebreathing bag is located on the inspiratory side of the CO_2 absorber, thus eliminating this hazard. However, in most machines, such as the Quantiflex or Ohio models, this is not feasible. In lieu of cleaning CO_2 absorbers between anesthesias, or using tubes with filters on the inspiratory limb, we feel that it would be best to discourage the distended rebreathing bag technique of testing a circle system.

A static pressure column will not dislodge soda lime. This can be created by occluding the face-mask orifice and then squeezing and releasing a *partially* filled rebreathing bag. Such a maneuver should eliminate the possibility of forcing CO_2 absorbent into the circle system's inspiratory limb.

The authors thank Mr. Louis Brunelle for photographic assistance.