Soda-lime Dust Contamination of Breathing Circuits

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Complications related to the design of the circle absorber on the Quantiflex anesthesia machine have occurred several times in the Western New York area and should be brought to the attention of anesthesiologists. On at least three occasions, soda lime dust has blown through the inspiratory limb of the tubing connecting the absorber to the patient in sufficient quantities to cause serious problems. The following case report is the first such accident recorded in the 18-year history of this deparment of anesthesiology.

REPORT OF A CASE

A 28-year-old woman was anesthetized with enflurane and nitrous oxide after induction with thiopental and intubation of the trachea following paralysis with succinylcholine. Half an hour after induction, decreasing compliance and wheezing were observed. No drug other than enflurane and nitrous oxide had been administered since induction. Anesthesia was deepened with enflurane after the tube's position was checked and it was confirmed to be properly placed and free of kinks. The wheezing continued. Because of lack of a history of allergy or asthma, it was believed that some mechanical problem might exist, so the inspiratory hose was disconnected at the Y connector. When the bag was squeezed, soda-lime dust could be seen coming out of the hose. Flushing the system with oxygen resulted in a marked increase in the amount of dust emanating from the hose. The anesthesia machine was immediately replaced with one of different manufacture with an Ohio circle absorber. The patient was given dexamethasone, iv, and the operation continued uneventfully. Compliance gradually improved, and the wheezing disappeared. Recovery was uneventful.

DISCUSSION

It was subsequently brought to my attention that similar accidents had occurred using the same model of machine in another hospital in this community. One such incident had resulted in burns of the patient's face.

This problem appears to be related primarily to the design of the absorber on the Quantiflex machine. Other factors are also involved. In this institution, high gas flows are used almost constantly. Total flows below 6 l/min are rarely employed. This leads to little or no wetting and caking of the lime, and high dust production. The present problem, combined with the increased contamination of the atmosphere and the deleterious effects of excess drying of the respiratory mucosa, leads me to question the wisdom of high-flow techniques. The advantage of a more constant inspired concentration of anesthetic vapor, which the high-flow technique assures, may be outweighed by these disadvantages.

The particular circle absorber in question has the bag on the expiratory side and the gas supply to the absorber coming through the bottom of a bowl-like canister (fig. 1). Dust collects in this bowl-like structure. Squeezing the bag or flushing the system puts a direct flow of gas into the immediate area of the dust collection and carries it out the inspiratory limb of the circle. Squeezing the bag with normal compliance does not expel

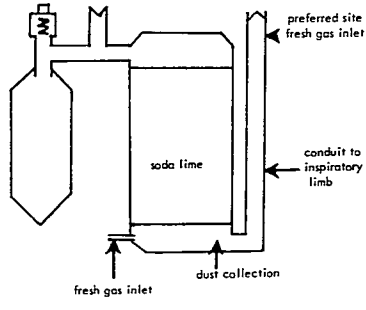

FIG. 1. Schematic representation of the Fraser-Sweatman absorber.

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FIG. 2. Bowl-like bottom of Fraser-Sweatman absorber, with the small port for fresh-gas inflow (*A*) and the large port for delivery of gas to the inspiratory limb in the center (*B*).

as much dust as flushing the system. However, in low-compliance situations, the high pressures required cause very appreciable quantities of dust to be expelled upon squeezing the bag. The essential difference between the Fraser-Sweatman absorber and Ohio Model 21 absorber is in the placement of the fresh-gas inlet. In the Ohio absorber the fresh-gas inlet introduces gas into the top of the absorber, avoiding high local velocities in a bowl-like structure containing dust. In the modification of the Fraser-Sweatman absorber available from the company, the fresh gas is led into the upper part of the conduit to the inspiratory limb, as illustrated in figure 1, as the "preferred site fresh gas inlet." Several machines of this design have been modified by the manufacturer, to change the position of the gas inlet, with improvement of the situation. It appears to me that further modification, perhaps by placing the breathing bag on the inspiratory limb downstream from the inspiratory valve, would further improve the situation.

Figure 2 shows the bowl-like bottom of the Fraser-Sweatman absorber with the small port for fresh-gas inflow on the right (*A*) and the large port for delivery of gas to the inspiratory limb in the center (*B*). The soda-lime particles collected in and about this large port are obvious. The diagram (fig. 1) illustrates the pathway of gas through this absorber and the manner in which dust can be conveyed to the breathing circuit.

SUMMARY

A case report of soda-lime dust contamination of the breathing circuit of an anesthesia machine causing bronchospasm in a patient is presented. Various factors in absorber design and increased dusting of soda lime due to high-flow techniques and lack of wetting are described. A modification of the Fraser-Sweatman absorber leading the fresh gas into an area free of dust accumulation has resulted in near-complete elimination of the problem.