

# NMT Gadgetry

## Reducing CO<sub>2</sub> Inhalation in Clinical Pulmonary Investigations

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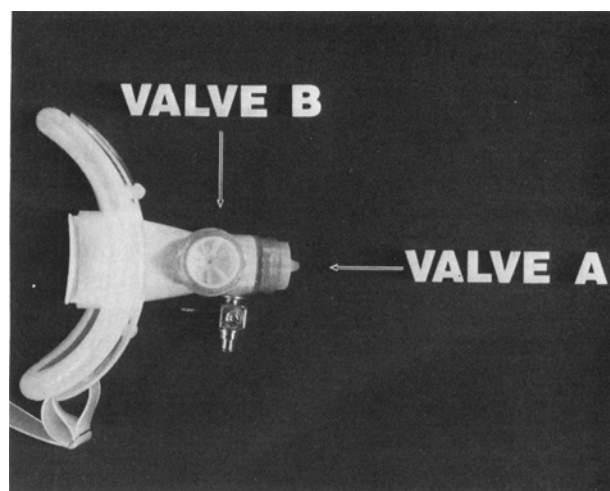
*Patient comfort during any scanning procedure always complements the quality of the scan being done. Many of our patients undergoing clinical pulmonary investigations were becoming progressively nervous; sometimes we were unable to complete the study. We later determined that this was caused by the rebreathing of expired CO<sub>2</sub> gas, which collected in a 12-in. flexible tube connecting the mouthpiece to the delivery arm of the machine. This problem was alleviated by affixing two one-way disposable valves to the mouthpiece in order to prevent backflow of expired CO<sub>2</sub> gas and at the same time allow fresh room air to be breathed. By eliminating the backflow of CO<sub>2</sub> and making it possible for the patient to breath easily in ample room air, we reduced the apprehension previously observed. As a result, complete and improved pulmonary function studies on our patients were produced.*

Occasionally, while doing clinical pulmonary investigations using the Ventil-Con controlled gas delivery system from RADX Corp., we received complaints from patients regarding difficulty in breathing. After talking with many of these patients, we learned that their discomfort was not caused by an air flow resistance, which could occur as a result of restricted air flow through the machine itself, but by rebreathing exhaled CO<sub>2</sub> found in the interfacing 12-in. flex tube, which extends from the mouthpiece to the breathing port. During inhalation, amounts of inhaled CO<sub>2</sub> greater than 4% above the normal level of CO<sub>2</sub> may cause the patient to have symptoms of dizziness, faintness, and headache (1).

### Materials and Methods

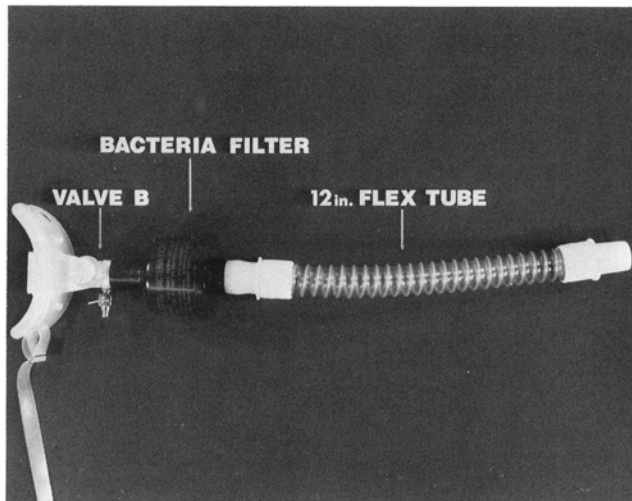
The mouthpiece was modified to accommodate two small disposable one-way check valves, 1.8 cm in diameter, seated within fixed adapters of the mouthpiece. The check valves (Fig. 1) actually work in opposition while the patient inhales and exhales through the

mouthpiece. Upon exhalation, valve A (Fig. 1) opens, allowing expired air to pass through a disposable bacteria filter (Fig. 2), the 12-in. flex tube, the air passages of the machine, and into a carbon-filtered xenon trap. Valve B (Fig. 1) remains closed until inhalation allows room air to pass through and immediately travel the short distance of 5 cm into the patient's mouth. Thus, during inhalation, valve A is closed, preventing the patient from rebreathing any exhaled air previously drawn from the 200-cc volume of air within the 12-in. flex tube. Use of the disposable bacterial filter is optional. It can be the connector between the 12-in. flex tube and the mouthpiece (Fig. 3) to prevent bacterial contamination of the airways leading to the filter in the machine. This makes it necessary to replace only the mouthpiece and the disposable filter prior to each study and eliminates having to gas sterilize the air passages within the machine after each patient. This is simply an extra safety precaution to take for patients with known communicable respiratory diseases ranging from the common cold to active tuberculosis.



**FIG. 1.** Valve A allows expired air to flow through on exhalation but closes on inhalation; valve B permits air flow into mouthpiece on inhalation.

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**FIG. 2.** During inhalation, valve A is closed preventing backflow of any exhaled air previously drawn from 200-cc volume of air within 12-in. flex tube; disposable bacteria filter connects mouthpiece to flex tube.

### Discussion and Conclusion

For normal or relatively strong patients, the rebreathing of expired gases collected in the 12-in. flex tube does not constitute a problem. These patients are capable of breathing deeply enough to inhale an adequate amount of fresh air through the room air intake port located underneath the delivery arm of the machine. However, for patients who have a severely reduced breathing capacity, the problem of overcoming this 12-in. dead air space by breathing deeply enough to replenish this space with fresh air through the room air intake port becomes an impossible task. Through modification of the mouthpiece, the patient is prevented from rebreathing the residual  $\text{CO}_2$  gas found with the 12-in. flex tube. In addition, by providing a more direct air way for inhalation, we have made the patient feel more relaxed.



**FIG. 3** Patient with modified mouthpiece prior to connection of 12-in. flex tube.

The availability of fresh room air eliminates feelings of suffocation, dizziness, and faintness caused by improper mixture of inhaled air.

### Acknowledgment

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### References

1. Best CH, Taylor NB: *The Physiological Basis of Medical Practice*, 8th ed. Baltimore, Williams and Wilkins, 1966, pp 1017-1018