ETHER-AIR ANESTHESIA: A TECHNIC

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THE use of high frequency current for electrocoagulation during ether anesthesia calls for an alteration in the usual anesthesia technics. We have been faced with the problem of decreasing the hazard of fire and explosion and increasing the safety of the anesthesia during long operations upon the spinal column, when the patient is in the prone position, and in operations about the head and neck.

Eversole (1), in a valuable contribution aimed at reducing the explosive hazard, recommended the delivery of an ether-air mixture, in large volume, to an endotracheal tube. Compressed air, a pump, or a foot bellows is used. The exhaled gases are carried to a point distant from the operative field. The technic as suggested by him has the advantages of the use of a relatively nonexplosive mixture, a patent airway and an unobstructed field for the surgeon.

He recommended the delivery of a large volume of air carrying the ether vapor through a tube of not less than ½ inch in diameter at a flow of not less than 12 liters per minute. The excess gases are streamed through a double length tube similar to the respiratory tubes on a circuit absorption gas machine. At the distant end of this tube is placed a tissue paper indicator of the flow of ether-air from this tube.

It is our feeling that under the circumstances described, a flow of 12 liters per minute or even more may not be sufficient to allow for complete tidal exchange in the absence of rebreathing.

In the average adult under anesthesia the respiratory rate may be 20 per minute and the tidal exchange 500 cc. In this instance the minute volume exchange is 10,000 cc. It would appear then that a delivery of 12 liters per minute is adequate without rebreathing. However, since there is no accommodation made for the accumulation of delivered gases on the inspiratory side during the expiratory and resting phases of respiration, the gases delivered during these periods are entirely lost to the use of the patient.

Since inspiration occupies about one-third of the respiratory cycle it follows that a volume at least equal to the minute volume exchange should be delivered during this phase of respiration. In order to satisfy the patient's requirements properly, it would be necessary to deliver 10,000 cc. each one-third of a minute or 30,000 cc. per minute. This would require a pump of great capacity and the use of very large amounts of ether.

We have accomplished the desiderata as proposed by Eversole and have obviated the use of a pump or compressed air by the simple expedient of employing a circuit type of anesthesia apparatus. After induction and intubation with a circuit type apparatus, the flow of ether is increased. The expiratory tube at the gas machine end is removed and an added length with a flutter valve attached to its distal end is

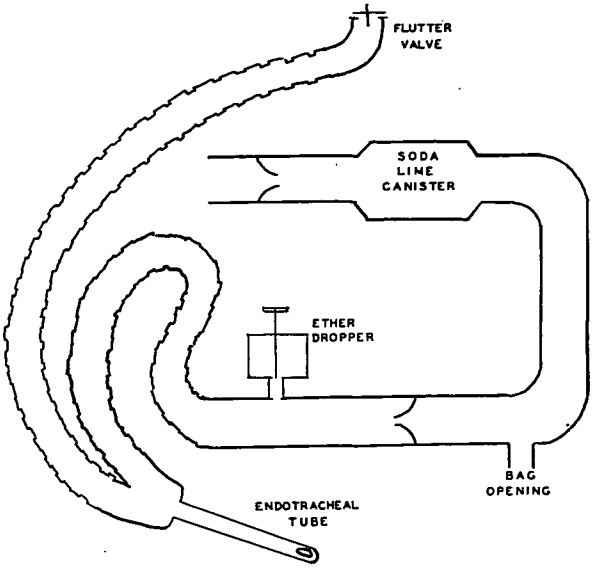

FIG. 1. Circuit type anesthesia apparatus, endotracheal tube, double length expiratory tube and flutter valve are shown.

added to it. The bag contents are then dumped by compression. The bag may or may not be removed. Oxygen may or may not be continued to be added from the gas machine as desired. We usually add oxygen in small amounts until such time as electrocoagulation is employed.

Under this arrangement room air is drawn through the expiratory port on the gas machine or through the bag opening by the patient's inspiration. Ether is added to it and the mixture inhaled through the inspiratory tube. Exhaled gases go through the double length expiratory tube, raising a flutter valve at a point distant to the high frequency apparatus or the coagulating electrode. This flutter valve at the end of the expiratory tube and the valve on the inspiratory side of the gas

machine prevent rebreathing and effect a continuous movement of ether-laden air in one direction through the apparatus. Dead space is reduced to a minimum. There is no space for carbon dioxide accumulation. There is no limitation to the volume of air inhaled.

It must be noted that a fairly rapid flow of ether is necessary to maintain a satisfactory plane of anesthesia since none of the atmosphere is re-inhaled.

FIG. 2. Flutter valve attached to the terminal end of the expiratory tube by means of a right-angle glass tube 1 inch in diameter.

This technic may be rapidly converted to a closed system should artificial respiration be required. It is only necessary to replace the bag and the expiratory tube.

We have used this technic only with a Connell machine. It should work equally well on any other machine in which the ether is delivered into the inspiratory tube by a dropper. It will not work well in an apparatus where the vaporization of ether is dependent upon a flow of compressed gases.

REFERENCE

1. Eversole, U. H.: Anesthesia for Surgery About the Head, J. A. M. A. 117: 1760–1764 (Nov. 22) 1941.