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Evaluation of the Elder Demand Valve Resuscitator for Use by First-Aid Personnel

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Exhaled air techniques of artificial respiration have had continued popularity in first aid circles because of their availability. Mechanical devices often have been found too complicated to be consistently reliable in the hands of first-aid personnel. A tight mask fit is difficult for such personnel to achieve in the wide range of victims who may need first aid. A diversity of control knobs on such devices gives rise to confusion and ineffective performance of resuscitation.

A simple new appliance, the Elder Demand Valve Resuscitator,† appears to overcome most of these objections. This device, operated by compressed oxygen, will deliver oxygen on demand and will also provide intermittent positive pressure respiration. The device can be operated either from a wall oxygen outlet, or from a tank with appropriate reducing valve. A maximum flow rate of 150 liters per minute can be delivered when the wall outlet pressure is 50 pounds per square inch. This is claimed to be enough flow to ventilate the victim in spite of major leaks around the mask. Positive pressure is applied by pressing a button; moderate pressure generates moderate oxygen flow rates, heavy pressure a flow up to 150 liters per minute. Flow ceases when a pressure of about 54 cm. of water is attained, even if the button is still depressed.

To determine whether this device might be useful to first-aid groups, the following tests were carried out with 10 full-time personnel of the ambulance service of the Baltimore County Fire Bureau. Their performance in ventilating the training mannikin, Resusci-Anne, was measured. The mannikin was prepared as previously described [1] so that gas put into the chest could be measured by a Wright Respirometer. Eight of the ten ambulance men had also participated in the cited study, and had been instructed previously in exhaled air and self-inflating bag methods. Methods of artificial respiration were by the mouth-to-mouth method, by means of a Pulmonator bag, and by the Elder valve. With the last two methods a large adult Scram mask was used. About two minutes of instruction was given in the use of the Elder valve, plus about thirty seconds of practice on the dummy. The men each performed all three methods of resuscitation. Measurements of respiratory rate and minute volume were made over a two minute period with each method. Mean tidal volumes were calculated from these data. Results are shown in table 1.

The values for rate, minute volume, and tidal volume, using the mouth-to-mouth method, did not differ significantly from those obtained with the Elder valve. The same values with the Pulmonator bag were significantly less

TABLE 1. Ventilation Achieved with Different Methods of Artificial Ventilation

Ventilation Method	Respiratory Rate (per min.)	Minute Volume (l./min.)	Tidal Volume (ml.)
Mouth-to-mouth	15.3±3.0	14.72±5.15	1,004±395
Pulmonator Bag	21.8±5.2	8.16±4.39	362±126
Elder Valve	16.6±3.3	14.30±1.59	895±182

Mean values for ten operators, with standard deviations.

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† Distributed by the Foregger Co. Inc., Roslyn Heights, N. Y.

($P < 0.05$) than those obtained by the other two methods.

In conclusion, the advantages of the Elder valve over previously available equipment and over the exhaled-air techniques include the following: (1) simplicity, (2) delivery of 100 per cent oxygen, (3) two hands can be used to maintain a mask fit, (4) high flow rate permitting adequate ventilation in spite of mask leaks, (5) avoidance of personal contact with the victim. The disadvantages are principally lack of ready availability and dependence on compressed oxygen as a power source.

REFERENCE

1. Pearson, J. W., Navarro, R. N., and Redding, J. S.: Evaluation of mechanical devices for closed-chest cardiac massage, Anesth. Analg. **45**: 590, 1966.

Bedside Measurement of Carbon Dioxide Response

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In the course of studying several patients with a peculiar syndrome of apnea, occurring upon loss of wakefulness (Ondine's curse),[1] it became necessary to determine the response to increasing concentrations of carbon dioxide with a minimum of equipment and a maximum of efficiency. The system shown in figure 1 was devised.

An intra-arterial Riley needle is inserted for withdrawal of blood for measurement of Pa_{CO_2}. Resting ventilation is measured by placing the anesthesia mask, with Wright ventilation meter attached, on the face of the patient and after nine minutes of quiet respiration ventilation is measured over a one minute period, while blood is being drawn for Pa_{CO_2}. The Pa_{CO_2} is measured with a Severinghaus electrode coupled to a Beckman 160 physiologic analyzer. One length of anesthesia rebreathing tubing (32 inches) is added to increase the dead space for carbon dioxide buildup and after nine minutes $\dot{V}_E$ and Pa_{CO_2} are measured in the same way. A second length of rebreathing tubing is then added and the procedure repeated. During the entire procedure three-hundred cc. of oxygen are added at the nipple of the mask adapter (fig. 1). Some typical CO_2 responses elicited by this technique are shown in figure 2.

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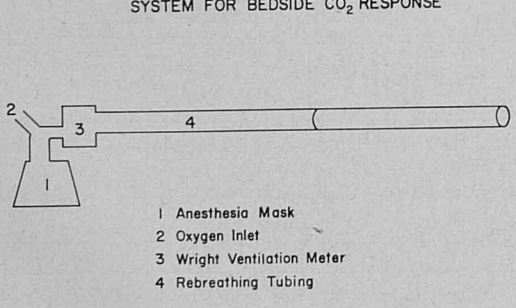

FIG. 1. Apparatus for bedside CO_2 response.

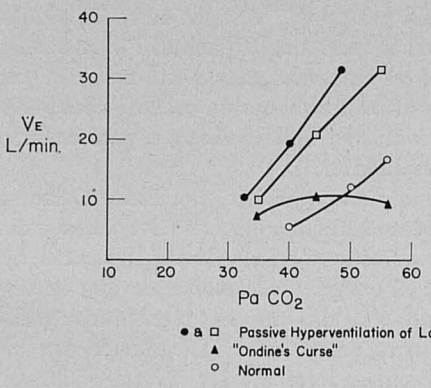

FIG. 2. Typical CO_2 response curves.

Although this system is not as accurate as other methods of measuring carbon dioxide response it does have the following advantages: (1) It is simple and portable. (2) Arterial Pa_{CO_2} is measured ruling out the effects of a-A CO_2 gradients on the response curve. (3) It measures the ventilation at different CO_2 levels, held constant for six minutes, allowing steady-state measurement and equilibration of