

Functional Disorders of Ruben and Ambu-E Valves after Dismantling and Cleaning

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The Ruben valve, which was introduced in 1952,¹ and the Ambu-E valve, which appeared some years later, are both nonbreathing valves commonly used in resuscitation equipment, in nonbreathing anesthetic systems, and as directional valves in circle systems, such as the Hafnia circle.² In our hospital during the last three years we have found at least 25 valves malfunctioning to such an extent that they posed a serious risk in the treatment of patients. The dangers of

incorrectly assembled Ambu-E valves have been described by Kelly³ and by Grogono and Porterfield.⁴

MATERIAL

Figure 1 is a drawing of the correctly assembled Ruben valve, together with the six types of malfunctioning valves found by us. Figure 1*b* shows the most common combination of defects, sticking of the bobbin and the expiratory valve. The modification shown allows neither inspiration nor expiration. If the expiratory port only is blocked, ventilation may create dangerous hyperinflation of the lungs.

Figure 1*c-f* shows incorrect assembling of either the bobbin or the spring, or both. Depending on the mobility of the bobbin and its location in relation to the valve seats,

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Received from the Department of Anesthesia, Rigshospitalet (University Hospital), Copenhagen, Denmark. Accepted for publication November 28, 1974.

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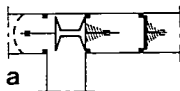
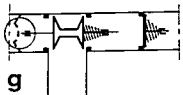
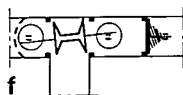
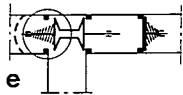
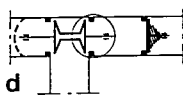
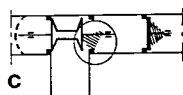
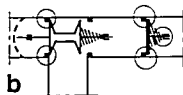


FIG. 1. Ruben valves: *a*, correctly functioning valve in inspiratory position; *b*, valve with sticking bobbin and expiratory valve; *c*, valve with the spring out of normal position; *d*, valve without the spring; *e*, valve with the spring positioned on the wrong end of the bobbin; *f*, valve with the spindle of the bobbin out of its bearings; *g*, valve with a dent in the wire net on the inspiratory side.



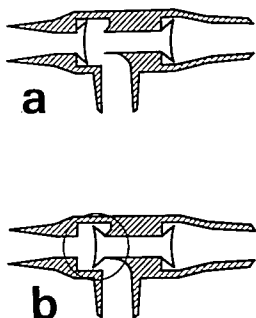


FIG. 2. Ambu-E valves: *a*, correctly mounted valve; *b*, the inspiratory disc-valve incorrectly placed on the central part of the valve.

these defects will result in increased resistance to inspiration and expiration, with the risk of rebreathing (the defect shown in figure 1c will result in 100 per cent rebreathing). In figure 1g the bobbin is prevented from closing against the left valve seat, resulting in partial rebreathing.

Apart from the defects shown in figure 1, it has been pointed out to us by Ruben² that displacement of the valve seats towards the center can occur, thus restricting the mobility of the bobbin and hindering the function of the valve.

Figure 2 shows a correctly assembled Ambu-E valve together with an incorrectly assembled valve, the only possible function of which is 100 per cent rebreathing.

COMMENTS

Most of the defects described probably occur when the valves are dismantled and

reassembled by inexperienced staff during cleaning procedures. Sticking of the bobbin and the expiratory valve can be caused by blood and secretions not removed during cleaning or by insufficient removal of cleaning detergents.

It must be stressed that the defects are particularly dangerous when the valves are used in resuscitation equipment because they will often be used by staff members who have had no training in anesthesia and thus have minimal ability to recognize functional defects.

We recommend: 1) that all valves be thoroughly checked before use in anesthesia practice or before being placed in resuscitation trolleys. This can be accomplished by controlling the function of the valve during both inspiration and expiration with an anesthetic bag attached to the patient's port; 2) that construction of the valves be changed such that dismantling the Ruben valve is hampered and incorrect positioning of the disc-valves in the Ambu-E valve is impossible; 3) that cleaning and necessary dismantling of the valves be performed by specially trained personnel only.

The authors thank Prof. H. Ruben for valuable advice and discussions.

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