A COMPOSITE SEMICLOSED ANAESTHETIC SYSTEM SUITABLE FOR CONTROLLED OR SPONTANEOUS RESPIRATION

BY

D. J. WATERS*
Department of Anaesthetics, Welsh National School of Medicine, Cardiff, Wales

For patients who are breathing spontaneously the Magill attachment or system A (Mapleson, 1954) is the most widely used semiclosed anaesthetic system. A theoretical analysis predicted that if the fresh-gas inflow were made at least equal to the patient's minute-volume ventilation, then rebreathing would be eliminated (Mapleson, 1954). A similar conclusion has been reached experimentally by various workers.

For patients whose respiration is manually controlled, however, a recent study (Waters and Mapleson, 1961) has shown that system D involves less rebreathing than system A. In the course of that investigation, an arrangement was devised which enabled the anaesthetist to change over easily from one to the other. This is now described in the belief that it may have some value in ordinary clinical anaesthesia when it is desired to avoid the use of soda lime.

* Present address: University College, Ibadan, Nigeria.

DESCRIPTION

Figure 1 illustrates the complete circuit. Two tubes run from the anaesthetic machine to the patient; one is a corrugated breathing tube and the other is a narrow-bore delivery tube. They lead to an expiratory valve mount (1). Both tubes take origin from a special device which plugs into the outlet of a Boyle's machine.

The tap (2) consists of two metal cylinders, one rotating inside the other. The inner cylinder (5) receives fresh gas from the Boyle apparatus but is permanently blocked off towards its other end. Gas escapes through an orifice in its wall. When the tap is in the "A" position this orifice is opposite another one in the outer cylinder. Gas passes out, and is led through a short metal tube (6) into the bag (4) and breathing tube. At the same time a prolongation of the inner cylinder closes off the pathway to the expiratory valve (3).

When the tap is in the "D" position the fresh
gas is directed along the narrow-bore tube instead of going into the bag. The expiratory valve (3) adjacent to the bag is now in action.

When system A is required the tap (2) is turned to the “A” position, and the valve (7) near the patient is brought into use. When system D is required, the valve (7) near the patient is closed, the tap (2) is turned to the “D” position, and the valve (3) near the bag operates; it needs only to be adjusted so that when the bag is squeezed, sufficient pressure can be built up in the system to inflate the patient’s lungs.

**DISADVANTAGES OF THE SYSTEM COMPARED WITH AN INFLATING VALVE**

1. Every time that a change is made from A to D, the valve near the patient must be manipulated. This may be inconvenient if the valve is covered by towels.

2. Because system D is not entirely free of rebreathing, even when the fresh-gas flow equals the minute-volume ventilation, a larger ventilation is needed to maintain a satisfactory alveolar carbon dioxide level. This may lead to a somewhat higher intrathoracic pressure, with its undesirable side effects.

3. The system, unlike most inflating valves, does demand some understanding on the part of the person using it.

**ADVANTAGES OF THE SYSTEM OVER AN INFLATING VALVE**

**In spontaneous respiration.**

When an inflating valve is used, the fresh-gas flow needs to be adjusted carefully. If the flow is too big the valve remains in the inflating position: the lungs are then held distended. If the flow is too small, the reservoir bag does not fill adequately during the expiratory phase: the bag empties while the patient is still trying to breathe in.

With system A the fresh-gas flow is far less critical. If the flow is too big, the excess escapes easily through the expiratory valve. If it is too small (less than the patient’s minute-volume ventilation) the bag refills in expiration but does so partly with alveolar gas which is rebreathed during the next inspiration.

**In controlled respiration.**

When an inflating valve (such as the Ruben) is used, the bag cannot be left unattended for long when the patient is apnoeic, or the valve may be forced into the inflating position and be held there. The anaesthetist is thus tied to the bag. If rhythmic inflation must be stopped for any reason, then the supply of fresh gas must be turned off. With system D the bag can be safely left alone provided that the expiratory valve (3) is made slack.

All inflating valves direct the patient’s expiration to the atmosphere and not back into the bag. Throughout the whole of the expiratory phase, therefore, the anaesthetist’s hand is out of touch with the patient’s airway and he may be unaware for a time that (for example) spontaneous respiration is returning. With system D the bag is always connected to the airway.

It may be added that when the device is used in the “D” position, and the bag is removed, then system E is produced (the T-piece system). System B can be produced if desired but it seems to offer no advantages.

**Messrs. Medical and Industrial Equipment Ltd.** have kindly agreed to manufacture the apparatus to order.

**ACKNOWLEDGMENT**

I am indebted to Mr. E. K. Hillard, L.I.B.S.T., Senior Technician to this Department, for advising on the design of the apparatus, and for constructing it.

**REFERENCES**
