

## A Simply Constructed Automatic Pressure-relief Valve

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Overdistention of the rebreathing bag is a hazard of assisted ventilation with a semi-closed breathing circuit. The usual practice is to close the springloaded pop-off valve partially so that excess gases are expelled during inflation of the lungs. Inflowing gases refill the bag during exhalation. Careful and frequent adjustments of the pop-off valve are necessary to maintain an appropriate reserve of gas. If the anesthetist's attention is diverted to measure blood pressure, adjust an intravenous infusion or make a notation on the anesthetic record, the bag may become overdistended. This, in turn, may result in

increased intrathoracic pressure, overdistention of the lungs and interference with venous return.

This report describes a simple valve constructed of a Penrose drain and plastic connectors, found in most operating suites. The valve vents the bag through its tail when no hand is on the bag, yet seals the bag completely when engaged by the compressing hand.

Three designs (fig. 1) have been tested in practice at Jackson Memorial Hospital for a year, and have been found satisfactory. Figure 1A shows a design which is virtually unkinkable. The valve is made of a 4- or 5-inch length of "medium" (5/8") Penrose drain, sealed by rubber bands to two segments of disposable polyvinyl suction tubing. The shorter piece of suction tubing (1½ to 2" in

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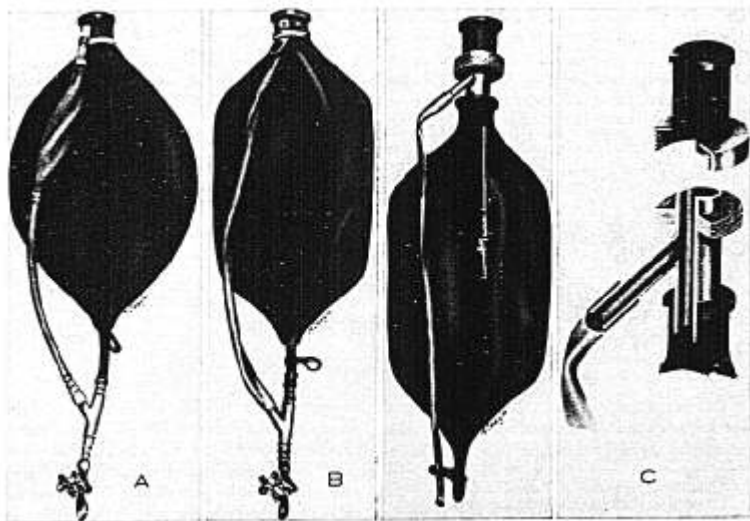


FIG. 1. Three versions of the pressure-relief valve.

length) is attached with adhesive tape to the neck of a rebreathing bag. The longer piece is fitted to a rigid nylon, serrated Y connector (model 3520, Sterilon Corp.), in turn inserted in the tail of the bag. The other arm of the Y connector is sealed with a short piece of amber rubber (tourniquet) tubing and a screw clamp. Because the valve is not sensitive to gravity, the bag may be mounted equally well on the anesthesia machine or at the end of a breathing tube, as in the Jackson-Rees modification of Ayre's T piece. Figure 1B shows a design simpler to construct, but more subject to kinking. The materials are the nylon Y connector, amber rubber tubing and clamp, and a longer length of small ( $\frac{1}{4}$ " or medium ( $\frac{3}{8}$ ") Penrose drain; the latter is stretched over the Y connector at one end, and trimmed to just reach the neck of the rebreathing bag, where it is attached with adhesive tape, without slack or undue tension. Some care is required in suspending the Penrose drain over the bag. The version shown in Figure 1C requires a special adapter,<sup>§</sup> but takes advantage of gravity to protect the Penrose drain from kinking. A 10- or 12-inch length of small ( $\frac{1}{4}$ ") Penrose drain, force-fitted over the side arm of the adapter, completes the assembly. This design is suitable only for mounting on an anesthesia machine. With each of the three designs, the overflow pressure within the

breathing system is less than 1 cm H<sub>2</sub>O at a gas inflow rate of 5 l/min.

The advantages of this design over other semiautomatic pressure-relief systems for use during artificial respiration include:

- 1) It is inexpensive and may be modified or adapted to individual needs.
- 2) It can be attached to any anesthesia machine or breathing circuit, e.g., to-and-fro, nonbreathing.
- 3) It cannot lock closed at any pressure, which can occur with other automatic pressure-relief valves.
- 4) This principle permits only two functions, "on" and "off." Either it is engaged and flow is interrupted, or it is not engaged and vents freely. Constant readjustment to accommodate changes of gas flow and type of ventilation is unnecessary.

Problems encountered during development included:

- 1) The Penrose drain tended to kink if too long or suspended too loosely. Designs B and C (see figure) were most susceptible to this fault.
- 2) Moisture collecting in the Penrose drain tends to make the drain sticky. Frequent replacement of the drain avoids this problem.

We believe that instructors in training institutions will appreciate the decreased incidence of overdistention of the breathing bag, and patients' lungs, which result from use of this valve.

§ Adapter manufactured by Ohio Medical Products and made available to us through the courtesy of Mr. Wayne May.

## CASE REPORT

### Cardiac Arrest during IPPV in a Newborn with Tracheoesophageal Fistula

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Esophageal atresia with tracheoesophageal fistula presents a major anesthetic risk because anesthetic gases can escape into the gastro-

intestinal tract during intermittent positive-pressure ventilation (IPPV). This causes gaseous distention of the stomach and may result in an acute rise of intraabdominal pressure which can be complicated by serious circulatory embarrassment and even cardiac arrest. The purpose of this report is to illustrate

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