

## Clinical Workshop

S. G. HERSHEY, M.D., Editor

### Nonslipping, Nonkinking Airway Connections for Respiratory Care

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Accidental disconnection between the patient's airway and the ventilator is one of the most serious and most common mechanical failures that occurs during prolonged artificial ventilation.<sup>1</sup> Although this problem has plagued us for years, manufacturers have been unable or unwilling to solve it. Sophisticated pressure monitors and alarms for ventilation do not solve the problem; they merely indicate the presence

of disconnection or obstruction without preventing it.

A simple, inexpensive, secure set of connectors † for use between the endotracheal or tracheostomy tube and the flex tubing leading to the ventilator Y or exhalation valve has been designed and produced from existing components (figs. 1-3).

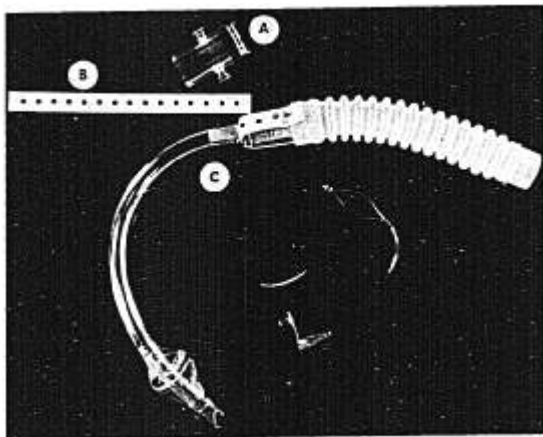
First, a slip-proof universal connector has been fabricated, using an existing intermediate plastic connector, the patient end of which is a 15-mm female/22-mm male adaptor, and the ventilator end, a 22-mm male adaptor, for corrugated tubing 22 mm in diameter (fig. 1).

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† Available from Instrumentation Industries, Inc., 215 Thomas Drive, Pittsburgh, Penna. 15236.

FIG. 1. A, slip-proof universal connector; B, elastic strap; C, A and B assembled with endotracheal tube and flex tubing.



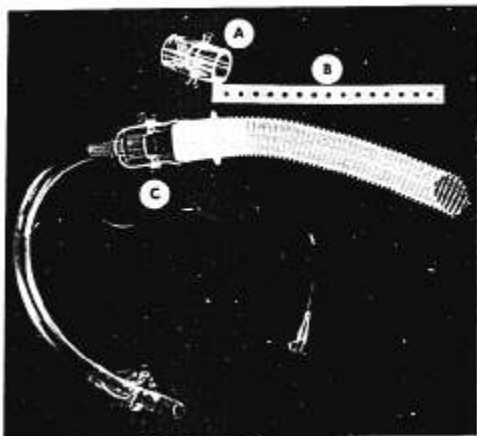


FIG. 2. A, slip-proof aerosol "T" connector; B, elastic strap; C, A and B assembled with endotracheal tube and large-bore aerosol tube (to nebulizer).

A groove and locking ridge are made on the ventilator end to provide a secure connection with the first corrugation of the flex tubing. Two small knobs (nipples) are bonded to the patient end of the universal connector. These knobs engage the ends of a soft rubber (Latex) strap. The center hole of the strap is slipped over the 15-mm male adaptor of the endotracheal tube—preferably, prior to sterilization. (If prior attachment is not possible, the strap may be applied after intubation.)

Second, the same slip-proof principle has been used for a modified T-tube system, used for spontaneous breathing of oxygen-air-aerosol mixtures via endotracheal or tracheostomy tube (fig. 2). A large opening (about 94 sq mm) is made in the wall of the slip-proof universal connector. As there is no reservoir bag, this hole is needed to permit the patient to draw in air when inspiratory flow rates exceed flow rates delivered from the nebulizer and to permit free exhalation.

Third, the principle has been used for interposing the Harris (Portex) single-swivel connector between endotracheal or tracheostomy tube and the corrugated tube section leading to the ventilator Y or the exhalation valve (fig. 3). This transparent plastic, single-swivel connector with two 15-mm adaptors

and a suction port is a compromise: we would prefer a dual-swivel connector, because it better prevents injurious traction and kinking of the airway. The Moersch dual-swivel connector (V. Mueller Company, Chicago), which we have used extensively in the past, is not slip-proof, is heavy, and does not have a standard 15-mm adaptor. We are using its pediatric modification, which is smaller than the Harris swivel (pediatric dual-swivel for tracheostomy tubes, Clarence Smith, Buena Vista Road, Arlington, Mass.). A lightweight, small, plastic dual-swivel connector with double 15-mm adaptors is not yet available.

The Harris single-swivel connector has been modified by bonding three knobs (nipples) to it. Two of the nipples are applied to the patient side of the swivel joint to accommodate the end of the elastic strap, the center hole of which had been slipped into a groove (or over a ridge) of the 15-mm adaptor of the tube. The third nipple is applied at the ventilator side of the swivel joint to secure the center point of the second elastic strap, the ends of which engage the nipples on the slip-proof universal connector. The universal connector, in turn, engages the corrugated tube section via the slip-proof, groove-ridge connection described above. The whole assembly is shown in figure 3.

COMMENTS

Approximately 100 patients per month have been admitted to our 16-bed intensive care unit. About half of them have received prolonged artificial ventilation via endotracheal or tracheostomy tubes. There were approximately five life-threatening accidental airway disconnections per month until October 31, 1970. These occurred in spite of the routine practice of taping all connectors. The newly-designed adaptors have been used since November 1, 1970, for all ICU patients needing artificial ventilation. There has been no accidental disconnection during the two months these adaptors have been in use.

Almost as many life-threatening disconnections occur at other sites in the air-train path of the ventilator-to-patient assembly as occur in the endotracheal airway, including separations of ventilator tubings from nebulizers, valves, or ventilators; leaking nebulizers; and electric wall-plug slippage.

Manufacturers should be encouraged to design and produce dual-swivel adaptors which incorporate the nonslipping characteristics shown here and, in addition, are small, short (not protruding more than necessary beyond the end of the tube), lightweight, without leaks, and have a 15-mm female patient end, a 15-mm male ventilator end, a lumen equal to or larger than that of the tracheal tube, and a

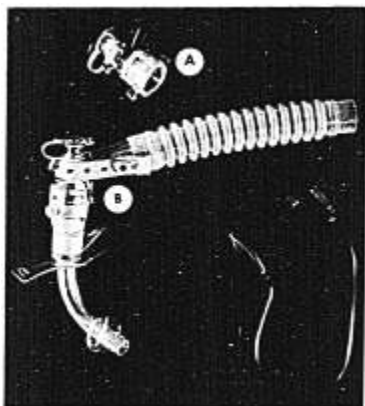


FIG. 3. A, slip-proof (modified) Harris swivel; B, A with slip-proof connector, flex tubing and tracheostomy tube.

slip-proof suction port which can be opened and closed quickly.

Dr. Peter Safar and Dr. Ake Grenvik made valuable suggestions.

REFERENCE

1. Safar P: Respiratory Therapy. Philadelphia, F. A. Davis Co., 1965 and 1971

## Clinical Implications of the Effect of Halothane on Depressed Rat Bone Marrow

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We have reported that halothane interferes with granulopoiesis in rats<sup>1</sup> and have investigated the kinetics of DNA synthesis in myeloid

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cells of these animals.<sup>2</sup> In the latter study, the rats received 0.55 per cent halothane for four hours, beginning concurrently with injection of tritiated thymidine (<sup>3</sup>HT). We learned that rat bone marrow takes two hours to equilibrate with inspired halothane, so only a portion of the four-hour exposure really tested the effect of halothane on the kinetics of myeloid precursor flow. The current study was undertaken to correct this flaw in experimental design, and the results of this and the previous