

CORRESPONDENCE

directly to the proximal end of the pediatric suction catheter, and end-tidal carbon dioxide is measured, producing a wave form that effectively monitors respiratory rate and rhythm. Supplemental oxygen is delivered to the patient by attaching the breathing circuit to the swivel arm of the BODAI suction connector. We found that increasing the flow of supplemental oxygen through the breathing circuit does not affect the carbon dioxide waveform, as long as the tip of the suction device rests at the skin edge of the tracheal stoma.

We found this device to be simple to prepare, nonirritating to the airway, and a reliable means to deliver supplemental oxygen and to

monitor end-tidal carbon dioxide in patients with tracheal stomas who require monitored anesthesia care.

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Potential Cause for Medication Administration Error

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To the Editor:—This correspondence is to inform the reader of a potential for drug administration error. An adult patient underwent general endotracheal anesthesia for laparoscopic cholecystectomy. The anesthetic consisted of isoflurane, oxygen, and intravenous narcotic. Neuromuscular blockade for intubation was achieved using rocuronium. At the conclusion of the operation, the patient was breathing spontaneously and had three twitches on train-of-four stimulation. The neuromuscular blockade was reversed using glycopyrrolate and neostigmine. Shortly thereafter, the patient's respiratory efforts ceased. At this point, no twitches could be elicited by train-of-four stimulation. We discovered that rocuronium, rather than glycopyrrolate, had been used for reversal of the muscle relaxant. The patient remained intubated during general anesthesia until reversal of neuromuscular blockade was possible. The patient was then extubated and had an uneventful recovery.

At our institution, the glass vials for glycopyrrolate (Robinul Injectable, Elkins-Sinn, Cherry Hill, NJ) and rocuronium bromide (Zemuron, Organon, West Orange, NJ) are approximately the same size. In addition to this problem, both vials have yellow caps covering the aspiration port (see fig. 1). Despite the brand name of rocuronium being clearly labeled on the yellow cap, we have seen the drug administered at the conclusion of an anesthetic necessitating reversal of neuromuscular blockade.

We contacted Organon regarding this problem. Although there is no substitute for constant vigilance in the practice of anesthesia, we believe that having color-coded caps and labels for different classes of medications may help to avoid serious drug administration errors.

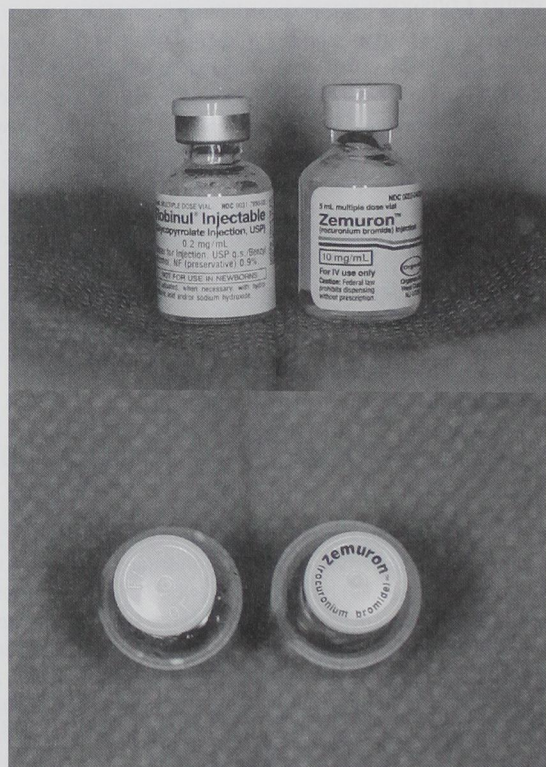


Fig. 1. Comparison of drug vials.

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References

1. Gravenstein JS, Paulus DA, Hayes TJ: The capnogram, *Capnography in Clinical Practice*. Stoneham, Butterworth, 1989, pp 11-30
2. Berk AM, Pace N: Use of the capnograph to detect leaks in the anesthesia circuit (letter). *ANESTHESIOLOGY* 1992; 77:836-7
3. Gravenstein JS: Gas monitoring and pulse oximetry. Stoneham, Butterworth-Heinemann, 1990, pp 73-5.
4. Food and Drug Administration: Anesthesia apparatus checkout

recommendations. *Anesthesia Patient Safety Foundation Newsletter* 1986; 1:15.

5. Malhotra V, Bradley E: Broken inner sleeve of a Y-connector: Course of a circuit leak and a potential foreign body aspiration (letter). *Anesth Analg* 1993; 76:1169-70.

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Another Cause of a Prolonged Downstroke on the Capnograph

To the Editor:—A prolonged downstroke on the capnograph during mechanical ventilation may be attributed to malfunction of the inspiratory valve, slow ventilation, or a leak *via* chest tube.^{1,2} We report an unusual cause of a prolonged downstroke.

A 22-yr-old, 65-kg man underwent elective discectomy of L4/5 for a prolapsed intervertebral disc. The anesthesia machine (Narkomed 4, North American Dräger, Telford, PA) that incorporated a circle carbon dioxide absorber system was checked preoperatively. No leaks were detected. The patient was intubated orally with a size 8.0 cuffed Ring-Adair-Elwyn tube (Mallinkrodt, Athlone, Ireland). The endotracheal tube was connected to a straight-expired gas sampling adapter (Straight T adapter, Datex Instrumentarium, Helsinki, Finland), and this was, in turn, connected to the circle system. The carbon dioxide sampling line attached to the adapter was connected to a built-in infrared side-stream analyzer with a sampling rate of 200 ml/min.

Mechanical ventilation was commenced with a fresh gas flow of 1.5 l/min (900 ml nitrous oxide, 600 ml oxygen, isoflurane, 1%), a tidal volume of 600 ml/min, a rate of 10 breaths/min, and an inspired-to-expired ratio of 1:3. This yielded a peak airway pressure of 22 cm water and an end-tidal pressure of carbon dioxide of 38 mmHg. However, the capnograph trace showed a prolonged downstroke corresponding to a shortened phase III. A check of the circuit revealed a soft hissing sound during inspiration. A crack was then noted on the inner sleeve of the straight adapter (fig. 1). This adapter was used previously and may have cracked as a result of its reuse. Replacement of the

straight adapter corrected the abnormal capnograph trace (fig. 2) but had little effect on the other parameters (tidal volume, 610 ml; peak pressure, 23 cm water; end-tidal pressure of carbon dioxide, unchanged).

The patient-end of the straight adapter can be used either as a male port for attachment of a face mask or as a female port for attachment of an endotracheal tube. To facilitate this, the straight adapter was designed with 15-mm inner sleeves and 22-mm outer sleeves, without obliterating the space in between. If there is a fracture of the inner sleeve, as in our case, entrainment of air into the circuit or leak of gases from the circuit may occur through the space between the sleeves. The dilution of expired carbon dioxide with entrained air produced the shortened phase III on the capnograph. Entrainment of air resulted from the continuous aspiration of the side-stream analyzer, because the use of a mainstream carbon dioxide analyzer does not reproduce the trace. This dilution, together with superimposed small tidal volumes from cardiac activity, also produced cardiogenic oscillations. These oscillations were readily observed because of the use of a low respiratory rate and an inspired-to-expired ratio of 1:3.³ In addition, a small leak occurred when peak inspiratory pressure was reached, producing the hissing sound.

This leak would not be detected with established anesthetic circuit checkout⁴ because both sleeves of the adapter would be occluded when the patient port is occluded, either by hand or with a test lung. A breakage of the inner sleeve in a similarly designed Y-connector has

Fig. 1. Photograph (*left*) and artist's rendition (*right*) showing a crack in the inner sleeve of the straight adapter extending from the patient-end inward and to the right.

