(Puritan-Bennett Corp., Foregger Medical Division, Langhorne, Pennsylvania).

We have combined several individual modifications in a single overall modification of a Miller-1 blade to facilitate difficult pediatric laryngoscopy and provide O_2 supplementation without risk of dislodgement of such loosely secured options as feeding tubes for O_2 insufflation or adhesive strips. A Miller-1 blade was fitted along its left side with a chrome-plated brass gas insufflation channel, corrugated along its lingual surface and widened in cross-section by bending the C-shape flange outward (figs. 1, 2). These modifications resulted in a laryngoscope blade that provided continuous gas insufflation, presented an atraumatic, nonskid surface to a slippery tongue, opened the rear aperture for improved glottic sighting, and had no loose attachments. We now have used this modified blade in a variety of clinical circumstances ranging from congenital anomalies (cystic hygroma, epignathus) to airway infections (croup, acute epiglottitis) and have found that it facilitates difficult endoscopy and provides unobtrusive oxygen or anesthetic insufflation when desired. Further adaptation of this modified brass blade (fig. 1) to a stainless steel instrument with a halogen lamp, cool fiberoptic illumination,* and appropriate battery-containing handle could result in a much improved pediatric laryngoscope with better illumination and little risk of thermal injuries.[9] These further modifications are beyond our budget and engineering expertise.

* Currently available on MacIntosh and Miller Halogen Fiberoptic Laryngoscopes, Welch Allyn, Inc., Skaneateles Falls, New York.

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REFERENCES

1. Buekes HvZ, Mostert JW: A new anatomic laryngoscope. ANESTHESIOLOGY 57:552–553, 1982
2. Matsuki A: New pediatric laryngoscope. ANESTHESIOLOGY 57:556, 1982
3. Rokowski WJ, Gurmarnik S: Laryngoscope blades modified for neonates and infants. Anesth Analg 162:241–242, 1983
4. Moynihan P: Modification of pediatric laryngoscope. ANESTHESIOLOGY 156:330, 1982
5. Wung J, Stork R, Indyk L, Driscoll JM Jr: Oxygen supplement during endotracheal intubation of the infant. Pediatrics 59:1046–1048, 1977
6. Cork RC, Woods W, Vaughan RW, Harris T: Oxygen supplementation during endotracheal intubation of infants. ANESTHESIOLOGY 51:186, 1979
7. Hencz P: Modified laryngoscope for endotracheal intubation of neonates. ANESTHESIOLOGY 53:84, 1980
8. Todres ID, Crone RK: Experience with a modified laryngoscope in sick infants. Crit Care Med 9:544–545, 1981
9. Toung TJK, Donham RT, Shipley R: Thermal burn caused by a laryngoscope. ANESTHESIOLOGY 55:184–185, 1981

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The Einstein Carbon Dioxide Detector

To the Editor:—Despite the most diligent efforts by anesthesiologists to confirm proper placement of the endotracheal tube, undiagnosed intubation of the esophagus still occurs, potentially with devastating consequences. The routine practice of auscultating both lung fields and listening over the stomach is mandatory. Auscultation over the stomach reveals characteristic sounds if the tube is in the esophagus. However, transmission of sounds to the lungs created by "ventilation" through an esophageal intubation may result in a false feeling of security. Furthermore, there are certain circumstances, particularly in obstetric anesthesia, where the abdomen is prepared prior to induction, that preclude abdominal auscultation. Maternal mortality reports from the United States[1] and United Kingdom* are potent reminders that failed intubation is an ongoing problem, with resultant mortality.

Murray and Modell[2] recently discussed various endotracheal tube accidents including esophageal intubation. They have established the value of carbon dioxide (CO_2) monitoring for confirming correct tube placement

* Crawford S: Failed Intubation (Editorial). Obstetric Anesthesia Digest 1:61–63, 1981.

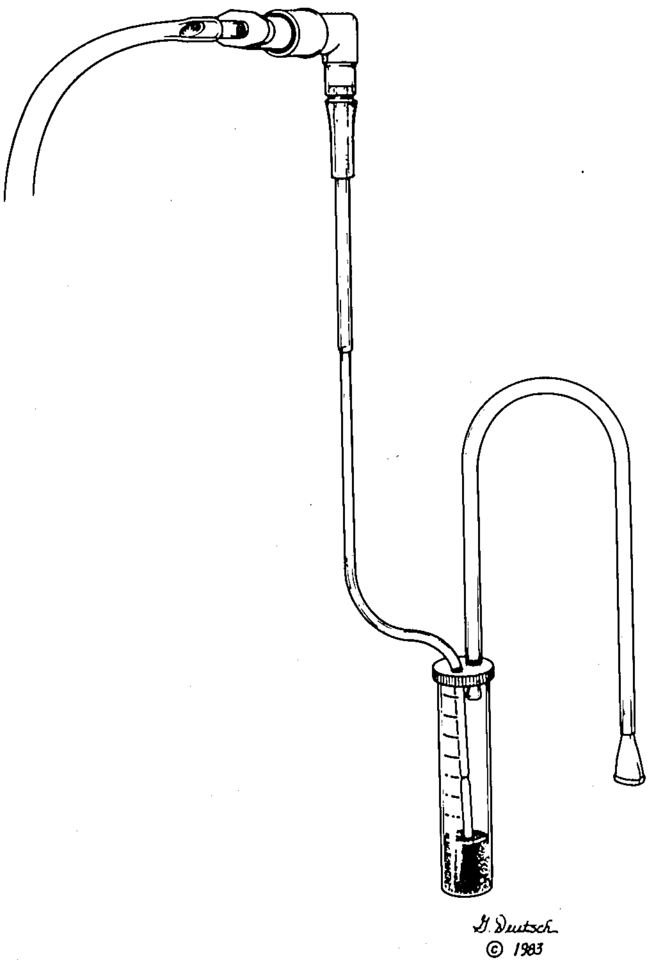

FIG. 1. The Einstein CO_2 Detector consists of a DeLee mucus trap and attached 15-mm adaptor with indicator solution in the chamber.

in emergency situations. Although a capnograph may be employed for these purposes, it is relatively costly, bulky, and currently not widely available in all settings where intubations are performed, *e.g.*, emergency rooms, paramedic ambulances, intensive care, and recovery units.

We have developed a reliable, inexpensive, and practical method for confirming intratracheal placement of the tube. The technique is based on the fact that expired air contains between 4% and 6% CO_2, whereas swallowed atmospheric air or gas from a properly functioning anesthetic circuit contains negligible amounts of CO_2. Prior studies have attempted to use various techniques to quantitate the percentage of CO_2 in respiratory gas and have relied upon the reaction of CO_2 with another substance[3,4] such as BaOH to produce a visible change. Our device is based on the chemical attributes of cresol red and phenophthalein. Both of these indicators change colors in the presence of an increased concentration of hydrogen ions resulting from carbonic acid. The device, The Einstein CO_2 Detector, is constructed by attaching a 15-mm adaptor to one end of a DeLee mucus trap. The chamber is filled with a mixture of 3 ml phenophthalein and 3 ml cresol (stock solutions). The catheter end of the mucus trap to which the 15-mm adaptor is attached is positioned so as to be well below the indicator fluid level (fig. 1). When CO_2 in concentrations in the range found in expired respiratory gas is bubbled through the chamber, there is a dramatic color change from red to yellow within 3–5 s. We have tested the device using oxygen, nitrous oxide, and the commonly used volatile anesthetics. They do not cause any color change nor does room air with a CO_2 content of less than 0.3%.

Clinical application of the Einstein CO_2 Detector is simple. Following intubation of the patient, the lungs are inflated and the proximal end of the endotracheal tube is occluded by a hemostat or similar device to prevent escape of expired gas. The 15-mm adaptor of the device then is attached to the endotracheal tube, and the hemostat is released, allowing the expired gases to bubble through the indicator solution. Failure of the solution to change from red to yellow should suggest esophageal intubation.

This device is not a substitute for the routinely used signs and skills used during intubation. Rather, it is a reliable, rapid, and inexpensive method for doubtful cases. Its maximum effectiveness in the operating room, delivery suite, and other areas is achieved by having it available with each intubation set for use in uncertain situations.

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REFERENCES

1. Marx GF, Finster M: Difficulty in endotracheal intubation associated with obstetric anesthesia. ANESTHESIOLOGY 51:364–65, 1979
2. Murray IP, Modell JH. Early detection of endotracheal tube accidents by monitoring carbon dioxide concentration in respiratory gas. ANESTHESIOLOGY 59:344–346, 1983
3. Smith RH, Volpitto PP. Simple method of determining CO_2 content of alveolar air. ANESTHESIOLOGY 20:702–703, 1959
4. Marriott WM. Determination of alveolar carbon dioxide tension by a simple method. JAMA 66:1594–1596, 1916

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