Understanding the Mechanics of Laryngospasm Is Crucial for Proper Treatment

To the Editor:

In their case scenario, “Perianesthetic management of laryngospasm in children,” Orlianguet et al. presented a 10-month-old boy who developed an inspiratory stridor after sevoflurane induction, which was initially managed by a jaw thrust and positive pressure ventilation. When the stridor recurred, manual ventilation became difficult with increased resistance to insufflation. Despite a jaw thrust, positive pressure ventilation with \( \text{FiO}_2 = 1 \), and propofol, the obstruction was not relieved and severe hypoxemia (oxygen saturation measured by pulse oximetry, or \( \text{SpO}_2 \), = 52%) ensued, requiring the administration of succinylcholine and tracheal intubation.

A basic understanding of the mechanics of laryngospasm is crucial for proper treatment. In his classic article, Fink described three types of laryngospasm: expiratory stridor, inspiratory stridor, and ball-valve obstruction. The stridors are controlled by the intrinsic laryngeal muscles, whereas the ball-valve closure is controlled by both the intrinsic and extrinsic laryngeal muscles. The expiratory stridor occurs as a result of active adduction of the vocal cords. The inspiratory stridor is produced passively as a result of the loss of tone of the abductor muscles. Because the velocity is greater where the passage is most narrow, airway pressure at the subglottic area becomes less than atmospheric during inspiratory efforts, and the passage of gases through the glottis generates a force that approximates the vocal cords together resulting in inspiratory stridor. Positive airway pressure can stent the airway and correct both expiratory and inspiratory stridors.

In ball-valve obstruction, laryngeal closure occurs at three levels: the true vocal cords, the false cords, and the redundant supraglottic tissue. The approximation of the vocal cords (and false cords) is swiftly followed by contraction of the extrinsic laryngeal muscles, shortening of the thyrohyoid distance resulting in complete closure, and cessation of airflow. In this situation, applying positive pressure can worsen the obstruction, as evidenced in the current case. By distending both pyriform fossae, the aryepiglottic folds are pressed more firmly against each other, which reinforces the closure. In contrast, the jaw thrust (also referred to as maximum mandibular advancement) can be effective in correcting ball-valve closure. The forward mandibular movement is transmitted through the geniohyoid muscles to the hyoid bone and the hyoepiglottic ligament. Consequently, the epiglottis and the redundant supraglottic tissue are pulled away from the false cords, and the laryngeal passage is reopened.

This letter was sent to the author of the original article, who felt that a reply was not necessary.—James C. Eisenach, M.D., Editor-in-Chief.
ever, it is frequently necessary, as in the case presented by Orliaguet et al., to administer succinylcholine to relieve this type of severe obstruction.

It is interesting that the expiratory stridor, which was common in the days of ether anesthesia and was regarded as “a vocal protest by the patient against inadequate anesthesia,” has virtually disappeared in modern anesthesia practice. In our recent quality-improvement study of laryngospasm, expiratory stridor did not occur in any patient. This is probably related to the use of sevoflurane yielding faster induction because of its low blood/gas partition coefficient.

We propose a simple algorithm (fig. 1) for the management of laryngospasm, which can be easily remembered and utilized by clinicians. Based on the mechanics of laryngospasm, this algorithm addresses both inspiratory stridor and ball-valve obstruction, but ignores the expiratory stridor because it is no longer observed in modern anesthesia practice. Positive pressure, which is effective in the management of inspiratory stridor, is avoided in ball-valve obstruction because it can worsen the obstruction. If a jaw thrust fails to correct ball-valve obstruction, succinylcholine is administered, followed by positive pressure ventilation and tracheal intubation.

M. Ramez Salem, M.D.,* George J. Crystal, Ph.D., Usharani Nimmagadda, M.D. *Advocate Illinois Masonic Medical Center and University of Illinois College of Medicine, Chicago, Illinois. ramez.salem-md@advocatehealth.com

Fig. 1. Algorithm for management of laryngospasm. Ball-valve obstruction is diagnosed by cessation of gas entry in spite of active inspiratory efforts. Succinylcholine is administered intravenously, but can be administered intramuscularly in case an intravenous access is not available. CPAP = continuous positive airway pressure; FiO₂ = fraction of inspired oxygen; PPV = positive pressure ventilation.

5. Isono S: One hand, two hands, or no hands for maximizing airway maneuvers? Anesthesiology 2008; 109:576–7

(Accepted for publication May 7, 2012.)

Ebenezer Hopkins Frost

To the Editor:

Ebenezer (Eben) Hopkins Frost (1824–1866) was the first patient to receive ether from William T. G. Morton (1819–1868) in the evening of September 30, 1846, in Morton’s dental rooms at 19 Tremont Row, Boston, Massachusetts. While researching the earliest known photographs of anesthesia,1 the author found that there was little information, some of it contradictory, on Frost. There were no publications on Frost, although there was significantly more information available on Edward Gilbert Abbott (1825–1855), who received ether from Morton on October 16, 1846, at Massachusetts General Hospital, Boston, Massachusetts.2

This biography of Frost will review the recorded information on Frost, and correct some of the errors in the details of his life and career. Frost’s encounters with Morton are also described.

M. Ramez Salem, M.D.,* George J. Crystal, Ph.D., Usharani Nimmagadda, M.D. *Advocate Illinois Masonic Medical Center and University of Illinois College of Medicine, Chicago, Illinois. ramez.salem-md@advocatehealth.com

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5. Isono S: One hand, two hands, or no hands for maximizing airway maneuvers? Anesthesiology 2008; 109:576–7

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