

found an overall mortality rate of 11.7% associated with a diagnosis of MH, which exceeds the in-hospital mortality reported for serious conditions affecting even older and sicker populations.¹⁻³ This high mortality in a low-risk population supports the idea that our estimates about the incidence and fatality rate of MH are not distant from the true values in the general population. Furthermore, although the cases were selected based just on a diagnosis code, coding by medical records departments depends on information provided by clinicians. Therefore, as we stated in our discussion, our results underscore the magnitude of the clinical problem, given that patients with a diagnosis of suspected MH should be treated as MH-susceptible until proven otherwise.

Although there are limitations to our study, we disagree with the letter authors in that we believe these data support an increase in the incidence of MH. Although one of the causes of increasing incidence could be increased awareness of the MH code, we do not believe that this issue had an important impact on the trend of our observations. MH is so rare that during the five-year study period, each coding department of the more than 5,000 hospitals of the NIS universe was exposed on average to only 0.5 MH cases. Accordingly, the hypothesis that the coders became aware of the MH code seems to be baseless. Furthermore, to minimize this bias, we excluded from the study data on the first 3 yr (1997 to 1999) in which the diagnosis of MH was available in the *International Classification of Diseases, 9th Revision, Clinical Modification*.

We agree with Larach *et al.* that the reports to North American Malignant Hyperthermia Registry provide excellent information, and any cases of MH must be reported to the Registry. In addition, the efforts of American Society of Anesthesiologists and Malignant Hyperthermia Asso-

ciation of the United States in obtaining the approval for MH coding are well recognized and commendable. In fact, our manuscript does not suggest that readers stop reporting to the Malignant Hyperthermia Association of the United States registry. Despite their limitations, administrative databases provide valuable information, and it is our belief that information from the administrative databases and registries complements each other and neither should be excluded as we try to better understand MH. We acknowledge the error in the reference on the introduction of our paper, which should make reference to the 5% mortality rate cited by European reports, and not to the rate reported by the North American Malignant Hyperthermia Registry study. Nevertheless, the MH-associated mortality rate remains controversial.

Eric B. Rosero, M.D.,* Adebola O. Adesanya, M.D., Carlos H. Timaran, M.D., Girish P. Joshi, M.B.B.S., M.D., F.F.A.R.C.S.I.

*University of Texas Southwestern Medical Center, Dallas, Texas.
eric.rosero@utsouthwestern.edu

References

1. Jamieson GG, Mathew G, Ludemann R, Wayman J, Myers JC, Devitt PG: Postoperative mortality following oesophagectomy and problems in reporting its rate. *Br J Surg* 2004; 91:943-7
2. Chiappini B, Camurri N, Loforte A, Di Marco L, Di Bartolomeo R, Marinelli G: Outcome after aortic valve replacement in octogenarians. *Ann Thorac Surg* 2004; 78:85-9
3. Scarborough JE, Pietrobon R, Tuttle-Newhall JE, Marroquin CE, Collins BH, Desai DM, Kuo PC, Pappas TN: Relationship between provider volume and outcomes for orthotopic liver transplantation. *J Gastrointest Surg* 2008; 12:1527-33

(Accepted for publication April 23, 2009.)

Anesthesiology 2009; 111:451-2

Copyright © 2009, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

Detecting the Etiologies of Acute Airway Obstruction Associated with the Laryngeal Mask Airway Supreme™

To the Editor:—We read the recent case report by Kleine-Brueggeney *et al.* with interest.¹ This report raises several questions. Details as to the patient's head position, height and weight, depth of device insertion, cuff inflation volume, and use of any of the known maneuvers to detect device malposition are critical for problem-solving in supraglottic airway management.

The *Laryngeal Mask Airway ProSeal™ (LMA-P™)* and *Laryngeal Mask Airway Supreme™ (LMA-S™)* were compared in two recent studies.^{2,3} In a series of 93 anesthetized, paralyzed, adult female patients, Eschertzhuber *et al.*² concluded that ease of insertion, gastric tube placement, and fiberoptic position are similar for the *LMA-P™* and *LMA-S™*, but oropharyngeal leak pressure and intracuff pressure are slightly higher for the *LMA-P™*. A prospective, randomized cross-over study comparing the *LMA-P™* and *LMA-S™* in 36 fasted female patients by Verghese found similar results.³ These studies suggest that many of the previously published findings regarding the performance of the *LMA-P™* may apply to the *LMA-S™*.

Kleine-Brueggeney *et al.* chose a size 5 *LMA-S™* for their patient. Airway obstruction developed immediately after cuff inflation. This clinical finding suggests several possible etiologies.

A recent study by Xue *et al.* found that head flexion impaired the passage of an orogastric tube *via* the drain tube of the *LMA-P™*.⁴ Patient head position was not specified by the authors.

The authors do not specify the patient's height and weight, only the body mass index of 30.2 kg/m². The reader must assume that the authors chose to insert a size 5 *LMA-S™* based on the manufacturer's recommended weight-based guidelines (size 5 *LMA-S™* for patients weighing 70–100 kg).

Goldman *et al.* recently presented a study in which correct *LMA-S™* size was chosen by correlating the patient's Guedel oral airway size. Guedel oral airway size was judged by aligning its tip with the angle of the jaw and its proximal end with the corner of the patient's mouth. This maneuver was done next to the patient's head just before anesthetic induction. In a series of 100 patients, 77% of women required a size 3 *LMA-S™* using an 80-mm, size 3 oral airway, while 77% percent of men required a size 4 *LMA-S™* using a 90-mm, size 4 oral airway as a size guide. The remaining patients required the next-largest size *LMA-S™*. Appropriate size of the *LMA-S™* was accurate using this method, regardless of the patient's body weight.

Other clinical findings that confirm appropriate *LMA-S™* size include insertion of more than 50% of the bite block at the level of the teeth/gums.⁵ The issue of acute airway obstruction may have resolved entirely if the authors had chosen to downsize to a size 4 *LMA-S™*, rather than to reinsert the size 5 *LMA-S™*.

The authors do not specify the amount of air used to inflate the cuff or its resulting pressure. Manufacturer's guidelines indicate that the cuff inflation volume should not exceed 45 ml for a size 5 *LMA-S™*. Clinically, overinflation of the cuff could lead to narrowing of the glottic inlet as a result of extrinsic compression. The combination of inappropriate size and cuff overinflation can cause the events described.

Finally, five types of *LMA-P™* malposition have been described after insertion.⁶ The incidence of *LMA-P™* malposition is approximately

Drs. Osborn and Behringer have served on the honorarium speakers bureau for LMA North America, Inc., San Diego, California. Dr. Verghese receives an annual honorarium from The Laryngeal Mask Company Limited, Jersey, Channel Islands.

Table 1. Diagnostic Signs for Correct Position *versus* Malposition with Airway Obstruction of the Laryngeal Mask Airway ProSeal™

	Correct	Distal Cuff in Glottic Inlet	Severe Epiglottic Downfolding	Glottic Compression
Resistance at insertion	Nil	In pharynx	In pharynx or nil	Nil
Location of bite block to incisors	Between	Proximal	Between	Between
Popping out of the mouth	No	Yes	No	No
Airway obstruction	No	Yes	Yes	Yes
Seal	Good	Poor	Good	Good
Drain tube leak	No	Yes	No	No
Drain tube patency	Yes	Yes	Yes	Yes
Esophageal leak	No	Possible	No	No
LMA-PTM pushed in further	No effect	Deterioration	No effect	Deterioration
Sniffing position/jaw thrust	No effect	No effect	Obstruction improved	Obstruction improved
Decreasing cuff volume	No change	No change	Obstruction unaffected	Obstruction improved

From Brimacombe JR⁷; used with permission.

5–15%. Three percent of LMA-PTM malpositions occur with the distal cuff of the device in the glottic inlet, severe epiglottic downfolding occurs in < 0.5%, and glottic compression occurs in 0.3%. These types of LMA-PTM malposition are associated with airway obstruction as diagnosed in table 1.⁶

The esophageal drain tube is designed to aid the clinician in detecting malposition.⁷ Free passage of a gastric tube *via* the drain tube provides information about the position and patency of the drain tube of the LMA-PTM or LMA-STM. The “bubble test” described by O'Connor and Stix⁸ detects misalignment of the distal tip of the LMA-PTM or LMA-STM with the glottic inlet. Reseating the LMA-PTM/LMA-STM with a jaw thrust maneuver may be helpful.⁶

The challenge of attaining expertise and facility with any new airway device remains the clinical problem to solve. This depends, in part, on review of the existing scientific literature as well as ongoing clinical experience. Kleine-Brucegeny *et al.* should be commended for initiating a clinical dialogue about the LMA-STM, a new but potentially useful advancement in airway management.

Irene P. Osborn, M.D.,* Elizabeth C. Behringer, M.D., Richard M. Cooper, B.Sc., M.Sc., M.D., F.R.C.P.C., Chandy Verghese, M.B.B.S., F.R.C.A. *Mount Sinai School of Medicine, New York, New York. irene.osborn@mssm.edu

References

1. Kleine-Brucegeny M, Theiler LG, Luyet C, Greif R: Acute airway obstruction caused by the new single use Laryngeal Mask Airway Supreme. *ANESTHESIOLOGY* 2009; 110:189–90
2. Eschertzhuber S, Brimacombe J, Hohlrieder M, Keller C: The laryngeal mask airway Supreme—a single use laryngeal mask airway with an oesophageal vent. A randomised, cross-over study with the laryngeal mask airway ProSeal in paralysed, anaesthetised patients. *Anaesthesia* 2009; 64:79–83
3. Verghese C, Ramaswamy B: LMA-Supreme—a new single-use LMA with gastric access: A report on its clinical efficacy. *Br J Anaesth* 2008; 101:405–10
4. Xue FS, Mao P, Liu HP, Yang QY, Li CW, He N, Xu YC, Liao X: The effects of head flexion on airway seal, quality of ventilation and orogastric tube placement using the ProSeal laryngeal mask airway. *Anaesthesia* 2008; 63: 979–85
5. Stix MS, O'Connor CJ Jr: Depth of insertion of the ProSeal laryngeal mask airway. *Br J Anaesth* 2003; 90:235–7
6. ProSeal LMA for ventilation and airway protection: in *Laryngeal Mask Anesthesia: Principles and Practice*. 2nd edition. Brimacombe JR (ed), Chapter 19. Saunders, Philadelphia 2005
7. Cook TM, Lee G, Nolan JP: The ProSeal laryngeal mask airway: A review of the literature. *Can J Anaesth* 2005; 52:739–60
8. O'Connor CJ Jr, Stix MS: Bubble solution diagnoses ProSeal insertion into the glottis. *Anesth Analg* 2002; 94:1671–2

(Accepted for publication April 23, 2009.)

Anesthesiology 2009; 111:452–3

Copyright © 2009, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

In Reply:—We thank Osborn *et al.* for starting an interesting debate about the use of new supraglottic devices in clinical practice without solid evidence on their performance.

As described earlier for the *Laryngeal Mask Airway ProSeal™* (LMA-PTM),¹ we reported an unexpected acute airway obstruction caused by the *Laryngeal Mask Airway Supreme™* (LMA-STM), which ultimately was interpreted as a medial displacement of the laryngeal inlet by the mask itself, leading to airway obstruction, stridor, and ventilation difficulty.²

The patient's head was in the neutral position without head flexion and slightly elevated, as recommended. His height was 1.78 m, he weighed 95.6 kg (body mass index 30.2 kg/m²). Based on the patient's characteristics and the recommendation in the LMA-STM instruction manual, the LMA-STM size 5 was the correct one. We acknowledge other suggestions regarding how to choose the right size of an LMA-STM.

In 2003, Stix *et al.* described malposition of the LMA-PTM indicated by the depth of the bite block.³ Whether this applies to the LMA-STM with its different construction as well is speculative, and we cannot comment on that. In our case, the bite block did not remain outside of the mouth.

We also cannot judge whether an LMA-STM size 4 would have changed the airway problem. Our report was not intended to show all possibilities how to resolve airway obstructions with the use of an LMA™, but rather to point out that such obstruction may happen.

Osborn *et al.* mention that the cuff volume of the size 5 LMA-STM should not exceed 45 ml. We completely agree that overinflation needs to be avoided carefully in any cuffed supraglottic airway device. Besides airway obstruction, it might also cause nerve damage.⁴ Clinical observation in the operating room showed us that even 45 ml often results in high cuff pressures. The cuff volume in the patient presented was well below 45 ml, leading to a cuff pressure of 60 cm H₂O.

Our clinical practice with the LMA-PTM includes the described methods to detect malposition. Whether these also apply to the LMA-STM needs to be proven. In the case described, we had the luxury of having a fiberoptic bronchoscope immediately available to directly visualize the reason for the airway obstruction.

We disagree that previously published findings regarding the performance of the LMA-PTM should automatically apply to the LMA-STM, as