Aspiration prevented by the ProSeal™ laryngeal mask airway: a case report

[Prévention de l'aspiration par le masque laryngé ProSeal™ : une étude de cas]

Niall R. Evans MBCHB DA(SA), Richard L. Llewellyn MBCHB FCA(SA), Susan V. Gardner MB CHB FCA(SA), Michael F.M. James FRCA FCA(SA)

Purpose: To describe a case of intraoperative passive regurgitation where the ProSeal™ laryngeal mask airway (PLMA) successfully protected the airway from the respiratory tract.

Clinical features: A 32-yr-old man was electively scheduled for change of dressings and application of plaster of Paris to both legs. A size 5 PLMA was inserted on the first attempt and the patient allowed to breathe spontaneously. Twenty-five minutes into the procedure brown fluid was noticed in the drainage tube of the mask. There was no change in respiratory pattern nor any evidence of coughing retching or vomiting. Twenty-five millilitres of fluid were suctioned out of the tube which tested positive for acid. The PLMA was left in place and the procedure continued uneventfully. After removal of the mask pH testing showed the dorsum of the mask to have a pH of 7 and the ventrum/bowl of the mask to be dry with a pH of 7. The patient had no respiratory symptoms in the recovery room and the postoperative course was uneventful.

Conclusions: This case illustrates that passive regurgitation can occur unexpectedly intraoperatively and shows that the PLMA can protect the airway during such an event by allowing the regurgitated fluid to pass up the drainage tube without leaking into the glottis.

Objectif : *Décrire un cas de régurgitation peropératoire passive où le masque laryngé ProSeal™ (MLP) a permis de protéger efficacement les voies aériennes du contenu gastrique.*

Éléments cliniques : *Le changement des pansements et l'application de plâtre de Paris aux deux jambes avaient été planifiés pour un homme de 32 ans. Un MLP 5 a été inséré au premier essai et le patient a pu respirer spontanément. Vingt-cinq minutes après le début de l'intervention, un liquide brunâtre a été noté dans le tube de drainage du masque. La respiration n'était pas affectée et aucune évidence de haut-le-cœur ou de vomissement n'était observée. Vingt-cinq millilitres de liquide ont été aspirés du tube et une analyse en a révélé un contenu acide. Le MLP a été laissé en place et l'intervention s'est poursuivie sans incident. Après le retrait du masque, un test de pH a montré que le bord dorsal du masque présentait un pH de 7 et la partie ventrale/creuse était sèche et avait un pH de 7. À la salle de réveil, le patient n'avait pas de symptômes respiratoires et la récupération s'est déroulée normalement.*

Conclusion : *Ce cas illustre le fait qu'une régurgitation passive puisse se produire de façon inattendue pendant une intervention et que le MLP peut alors protéger les voies aériennes en permettant au liquide régurgité de passer dans le tube de drainage sans aller dans la glotte.*

THE Proseal™ laryngeal mask airway (PLMA; Laryngeal Mask Company, Henley-on-Thames, UK) is a new laryngeal mask device with features designed to isolate the airway from the digestive tract and prevent fluid aspiration. Studies indicate that the PLMA achieves a more effective seal than the classic LMA and isolates the glottis from the esophagus when correctly positioned.[1–3] The drainage tube of the PLMA travels from the tip through the bowl of the mask to lie alongside the airway tube (Figure). A recent cadaver trial showed that a correctly placed PLMA isolated the airway by allowing fluid pumped into the esophagus from below to pass up the drainage tube without leaking into the glottis or oropharynx.[4] We describe a case of intraoperative passive regurgitation where the PLMA successfully channelled fluid away from the respiratory tract.

Case report

A 32-yr-old man (ASA I, weight 60 kg, height 176 cm) was scheduled electively for change of dressings and plaster of Paris application to both legs. He had been involved in a motor vehicle accident six days previously

From the Department of Anaesthesia, University of Cape Town, Groote Schuur Hospital, Observatory, Cape Town, South Africa.
Address correspondence to: Dr. Niall R. Evans, Department of Anaesthesia, University of Cape Town, Groote Schuur Hospital, Observatory, Cape Town 7925, South Africa. Phone: +27-828986891; Fax: +27-821318986891; E-mail: niall@wol.co.za
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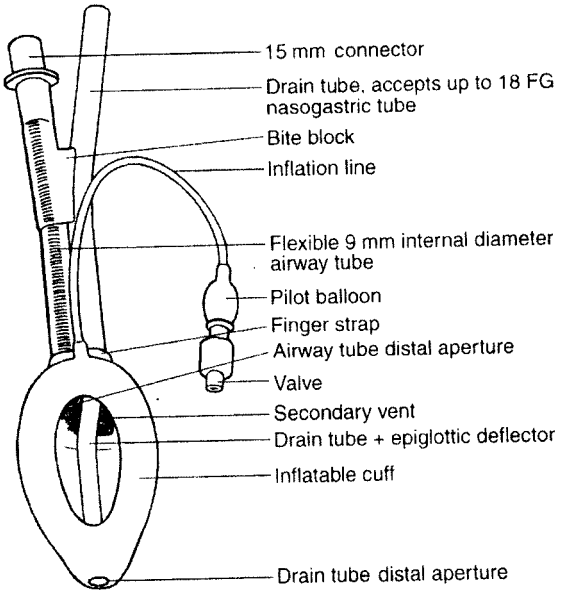

FIGURE The ProSeal™ laryngeal mask airway seen from the front.

during which he had sustained bilateral compound tibial fractures. Prior to the accident he had been well with no history of medical problems. At the preoperative visit he reported no heartburn or other gastro-intestinal symptoms and was not considered a risk for aspiration. Clinical examination was unremarkable apart from the orthopedic injuries. He was apyrexial and was receiving paracetamol 500 mg orally every six hours. He was starved overnight and premedicated with temazepam 20 mg one hour preoperatively.

Anesthesia was induced with fentanyl 65 µg followed three minutes later by propofol 200 mg and maintained with isoflurane 1–2% in nitrous oxide and 33% oxygen at a fresh gas flow of 3 $L \cdot min^{-1}$ in a circle system with the patient breathing spontaneously. A size 5 PLMA was inserted easily on the first attempt using an introducer with the recommended technique as described by the manufacturer. The cuff of the mask was inflated with 35 mL of air to obtain an intracuff pressure of 60 cm H_2O as measured by a calibrated aneroid manometre (Carron medical® control instruments RSA) and the lungs were ventilated easily, obtaining exhaled tidal volumes larger than 8 $mL \cdot kg^{-1}$. Adequate position of the mask was determined as recommended by Brain[1] by sealing the proximal end of the drainage tube with lubricating jelly, pressurizing the breathing system, and noting the pressure at which gas leakage occurred. Leakage occurred from the mouth at 20 cm H_2O with no leakage of air occurring up the drainage tube. Auscultation of the epigastrium revealed no gastric insufflation. A lubricated 16 G gastric tube was passed easily down the drainage tube into the stomach and 30 mL of fluid were aspirated using a 50-mL catheter tipped syringe. The fluid tested positive for gastric contents with litmus paper sensitive to changes of 1 pH unit from pH = 1 up to pH = 10 (Duotest® Macherey-Nagel Duren, Germany). The gastric tube was then removed.

Twenty-five minutes into the procedure brown fluid was noticed in the drainage tube of the mask. There was no corresponding change in respiratory pattern or any evidence of coughing, retching or vomiting. Exhaled tidal volume, respiratory rate, end-tidal carbon dioxide and percentage saturation of hemoglobin all remained constant. The mean arterial blood pressure and heart rate showed no change from maintenance levels of 70 mmHg and 80 $beats \cdot min^{-1}$ respectively. Twenty-five millilitres of fluid were suctioned out of the tube and tested positive for acid. The PLMA was left in place and the procedure continued uneventfully.

On awakening, when the patient could open his mouth to command, the PLMA was removed partially inflated and the dorsum and ventrum of the mask were tested with the litmus paper. The dorsum had a pH of 7 and the ventrum/bowl of the mask was dry with a pH of 7. The patient had no respiratory symptoms in the recovery room and the postoperative course was uneventful.

Discussion

This case illustrates that the PLMA is capable of protecting the airway in the event of passive regurgitation intraoperatively by allowing the regurgitated fluid to pass up the drainage tube and bypass the glottis.

The potential for aspiration is the most limiting feature of the classic LMA[5] and has been the subject of a recent editorial review.[6] Studies involving esophageal manometry[7] and lower esophageal pH studies[8] suggest that lower esophageal relaxation occurs during LMA anesthesia. The incidence of silent regurgitation during LMA use is varyingly reported by different groups to be between 0%[9,10] and 80%[11,12] and it has been suggested that this incidence is technique dependent.[13] Proper case selection and optimal techniques of placement as well as the maintenance of adequate levels of anesthesia throughout the procedure have been suggested as important contributory factors in the genesis of regurgitation during LMA anesthesia.[14]

The incidence of clinically detected regurgitation and aspiration derived from a meta-analysis of 547

LMA publications is approximately 1% and 0.02% respectively.[5] This incidence of aspiration is similar to that reported for elective general anesthesia overall,[15,16] although the two groups may not be comparable as "elective anesthesia" includes patients with potential full stomachs, a situation in which laryngeal masks are avoided.

However, no large retrospective or prospective studies are available examining the true incidence of aspiration with the LMA. The risk of unexpected regurgitation during anesthesia with a LMA remains, with no assurance of protection against aspiration.

Does the PLMA (particularly in view of its larger size) increase the risk of regurgitation? Although Vanner[17] showed that the upper esophageal sphincter (UOS) is competent during spontaneous ventilation LMA anesthesia, Brain *et al.* in a pilot study of a prototype LMA point to the concern of a larger mask stretching and opening the UOS.[18] Brimacombe and Keller found 2/60 patients to have an open UOS with the PLMA in place,[2] and found the UOS to be open in the case of a regurgitation they documented.[19] Opening of the UOS by the larger size of the PLMA may have been contributory in our case, although no fibreoptic visualization down the drainage tube was performed. Recent work by Brimacombe and Keller found that the PLMA had no effect on both UOS pressure and gastroesophageal barrier pressure in awake subjects.[20] Further work should be done measuring the affect of the PLMA on the upper and lower esophageal sphincters during general anesthesia.

The ability of the PLMA to protect the airway during regurgitation depends on:[19]

- the correct alignment of the drainage tube with the esophageal sphincter
- the efficacy of the seal of the distal cuff with the hypopharynx
- the pressure of the regurgitated fluid

The improved reliability of positioning of the PLMA is achieved by testing:[1]

- the absence of gas leak up the drainage tube below 20 cm H_2O airway pressure
- exhaled tidal volume larger than 8 $mL \cdot kg^{-1}$
- the passage of a gastric tube

These tests have been shown to predict effective isolation of the glottis from the esophagus while the mask is correctly positioned.[2] In this case, the above tests predicted adequate alignment of the drainage tube and isolation of the glottis. Successful passage of the gastric tube also indicates that the tip of the mask has not folded posteriorly during insertion; this malposition may lead to gastric insufflation as described in a recent case report.[21]

Cadaver studies have investigated the barrier to regurgitated fluid created by the classic LMA[22,23] and the PLMA[4] by ligating the esophagus below the pharynx and infusing fluid into the esophagus using a continuous flow, pressure controlled pump. A fibreoptic bronchoscope was used to visualize when fluid appeared above and below the cuff of the mask. When inflated with 10 mL of air or more, the LMA and the PLMA with a clamped drainage tube were shown to prevent fluid leaking above and below the cuff until a pressure of 46–49 cm H_2O was reached in the esophagus. This value increased to 63–68 cm H_2O at higher cuff volumes for the clamped PLMA. With the drainage tube unclamped no leak above or below the cuff was found with the PLMA as fluid was successfully channelled upwards without any leak into the glottis or oropharynx.

The pressure generated during passive gastroesophageal reflux is normally less than 10 cm H_2O and rarely exceeds 30 cm H_2O.[24] The PLMA would be therefore expected to protect the glottis during passive regurgitation as occurred in this case. However, during retching or vomiting the pressure of the fluid can be expected to be higher, and the correct positioning of the mask itself is likely to be disrupted, resulting in the loss of the functional isolation of the respiratory tract.

An earlier prototype study in children[25] had one episode of regurgitation in 50 cases; aspiration did not occur as the fluid passed up the drainage tube without leak into the bowl of the mask; the position (open/closed) of the UOS in this case is not documented.

Three reports have been published where an earlier prototype PLMA protected against aspiration in adults.[26–28] Brimacombe describes more than 500 uses with one detectable incident of regurgitation in a recent report which describes a case where the PLMA successfully channelled regurgitated fluid away from the respiratory tract during the early postoperative phase.[19] Another recent case is described where the PLMA protected against aspiration of fluid regurgitation which occurred intraoperatively.[29]

This case further illustrates that passive regurgitation of fluid can occur unexpectedly intraoperatively and shows that the PLMA can protect the airway during such an event.

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