Laryngeal mask airway (LMA-ProSeal) malfunction causing acute airway obstruction

Binu Puthur SIMON and Syed Harun HABIBULLAH
Department of Anaesthesiology, RIPAS Hospital, Brunei Darussalam

ABSTRACT
The Laryngeal Mask Airway ProSeal™ (LMA-ProSeal™; Laryngeal Mask Company Limited) is a reusable supraglottic airway device developed to enhance supraglottic airway protection and extend the benefits of the classic LMA (Laryngeal Mask Airway) to greater number of patients. Added features include an additional drain tube to channel fluid away from the airway and a tighter seal against the glottic opening with no increase in mucosal pressure. Clinicians have extended the use of the LMA-ProSeal™ inside and outside the operating theatre including use for difficult airway management and airway rescue. However, even these new devices have their limitations. We report an unforeseen acute airway obstruction caused by LMA-ProSeal™ malfunction during ophthalmic surgery. The cuff of the device was deformed with herniation to one side upon insufflation of the balloon.

Keywords: Laryngeal mask airway, malfunction, complications, LMA-ProSeal

INTRODUCTION
Laryngeal masks are used broadly for elective and emergency airway management and are an essential part of the American and European difficult airway management algorithm. 1-3 Due to their wide use, noticeable complications and side effects have been reported over the last years. The rare reports of airway obstruction directly triggered by the laryngeal mask are swelling of the pharyngeal soft tissues caused by the leakage of irrigation fluid, 4 herniation of the laryngeal mask airway cuff, 5-7 foreign bodies (Ascaris lumbricoides), 8 and intermittent obstruction related to a vagal nerve stimulator. 9 We report the case where an unanticipated airway problem arose due to a defect in a reusable Laryngeal Mask Airway ProSeal™ (LMA-ProSeal™) when it was used for an ophthalmic procedure. Upon careful investigation post procedure, the inflatable part of the device had weakened and ballooned out causing deformation of the mask resulting in loss of proper fit and seal.

CASE REPORT
A 48-year-old man with a body mass index of 38.9 kg/m² was scheduled for Trans Pars Plana Vitrectomy and intra-ocular lens insertion of the left eye under general anaesthesia. His
past medical history was relevant for obstructive sleep apnoea, hypertension and diabetes mellitus.

The patient was pre-oxygenated with 100% oxygen for three minutes and general anaesthesia was induced with 200mgs of propofol and 75mcgs of fentanyl. Anaesthesia was maintained with oxygen, nitrous oxide and isoflurane. Mask ventilation was fairly easy and intravenous atracurium (40mg) was given for relaxation. A size 4 cuff LMA-ProSeal™ laryngeal mask airway was successfully placed after checking of the cuff with 30ml air insufflation. The cuff was inflated with 20ml of air. The patient was ventilated with pressure controlled ventilation (PCV) mode with following parameters; inspiratory pressure of 15cm H₂O, respiratory rate of 12 per minute and an inspiratory: expiratory (I:E) ratio of 1:1. An I:E ratio of 1:1 was preferred to achieve a higher tidal volume at a lower pre-set inspiratory pressure (normal ratio is 1:2). The patient could generate around 550mls of tidal volume with the above settings. As a precautionary measure, a size 12 nasogastric tube was introduced through the drain tube of the laryngeal mask airway (LMA). His end tidal CO₂ was 35-40mm of Hg (Normal range 35 to 45mm of Hg).

Thirty minutes into the surgery a gradual decrease in tidal volume (350ml) and a rise in the end tidal CO₂ were noted. An additional dose of atracurium (40mg) and fentanyl (75mcgs) were given on the assumption that the effect of the initial dose was wearing off, but there was no improvement. Then the ventilator mode was changed to volume control with the following setting; tidal volume of 500ml and respiratory rate of 12/minute.

After this adjustment, the peak airway pressure went up to 29-30cm of H₂O and the mean airway pressure was around 17cm of H₂O. The end tidal CO₂ was maintained at 48 to 50mm of Hg. We managed to continue with this strategy for another 40 minutes.

Approximately 10 to 15 minutes before completion of surgery, breathing attempts by the patient were noted and we attempted to manage the patient on spontaneous ventilation mode with manual assistance. It was noticed that at this point there was hardly any end tidal CO₂ trace and the reservoir bag did not show any movement. The patient seemed to be experiencing acute airway obstruction during spontaneous attempts of breathing. The patient was paralysed with a 10mg dose of atracurium. Volume control mode was reinstated with the same settings as before. The patient was then satisfactorily ventilated until the surgical procedure was completed.

An intravenous dose of neostigmine and atropine were then administered to reverse the residual effect of the muscle relaxants. When breathing attempts commenced, the patient appeared to be further exhibit airway obstruction. At this point the LMA-ProSeal™ was removed and a Guedel airway (size 4) was inserted. The patient was ventilated with a face mask until a good respiratory effort was observed. Further recovery was uneventful. The LMA-ProSeal™ was later examined and it was noted that the cuff was deformed with herniation to one side (Figure 1). A faulty LMA with herniation after insufflations, together with formation of a fold on the cuff was suspected as the cause of the airway problem we had encountered in this case.
DISCUSSION

Cases of herniation have been reported with the Classic LMA™ airway. There was a case where the plastic layers between the inflated cuffs of a disposable LMA™ had separated and resulted in a herniation and, another case where the classic reusable LMA had herniated, probably as a result of material fatigue following repeated sterilisation.

In this case, we suspected herniation (deformation) of the LMA occurred intraoperatively causing leakage around the LMA-ProSeal™. A fold formed on the cuff facing the laryngeal inlet (Figure 1 b). The deformation led to loss of proper seal causing the subsequent events.

Though we were successful in ventilating the patient using the volume control mode, the peak airway pressures were high (30cm of H₂O) despite administering a repeat dose of muscle relaxant. Initially we were able to get the same tidal volume at a setting of 15 cm H₂O with pressure control mode.

With intermittent positive pressure ventilation (IPPV) and adjustment to volume control we succeeded in ventilating the patient adequately. Since a constant flow of gas is delivered in the volume control mode, more tidal volume was achieved with the same airway pressure, unlike the decelerating flow noticed in pressure control mode. Moreover an airway obstruction at laryngeal inlet could generate an auto positive end expiratory pressure (PEEP). This intrinsic PEEP together with long inspiratory time places the patient on a less compliant (over distended) part of the volume pressure curve.

When the patient started breathing spontaneously the obstruction became more severe causing inadequate ventilation. The reasons for almost complete airway obstruction once spontaneous breathing commenced could be due to the deformed cuff displacing the LMA inlet away from the glottis. This effect possibly got worse with the negative pressure caused by spontaneous inspiratory
efforts. In this particular case, LMA-ProSeal™ was preferred over the endotracheal tube to obtain smooth recovery and avoid the stress of extubation occurring after posterior chamber eye surgery.  

LMA-ProSeal™ was used as we could take extra precautionary measures against aspiration and gastric distension (like insertion of an orogastric tube). Additionally, LMA ProSeal has proven to have better seal at higher ventilating pressures.

There have been case reports of herniation of the classic reusable type LMA, possibly as a result of overuse, over inflation or repeated sterilisation. Repeated uses of LMA™ airways beyond 40 uses increases the probability of device malfunctions. In this particular case we were unable to determine how often the LMA-ProSeal™ had been subjected to repeated use. As a standard practice we utilise a cuff volume of 20-30 ml for LMA-ProSeal™ size 3 in accordance with manufacturer recommendations and, our sterilisation complies with manufacturer instructions.

Since the head was draped and covered for our case, we did not have access to the airway such that, in the worst case scenario of total airway obstruction we would have been left with no choice but to stop the surgery and replace the faulty LMA with an oral endotracheal tube.

Cuff herniation of the LMA-Classic may not be apparent if the cuff is inflated with volume less than the recommended maximal volume (e.g., 30 ml for size 4) and may only become apparent when inflated with a volume of air 50% greater (45 ml). This practice is now recommended by the manufacturer. We recommend this practice to be followed in LMA-Pro Seal™ prior to insertion.

In conclusion, when a ventilation problem is encountered with a reusable LMA™, particularly if this had experienced repeated sterilisation, a herniated cuff should be considered, even if initial testing was inconspicuous. Removal of the malfunctioning LMA™ and inspection of the cuff should be considered to rule out this potentially deleterious technical problem.

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Brunei Darussalam — Healthcare in Pictures

Hj Ahmed Yunos Bin Hassan (Dresser) doing his daily round with his team in the surgical ward of the Brunei General Hospital.

(Picture courtesy of Dayangku Dr Siti Nur’Ashikin Bte Pengiran Tengah).