Conclusion

LMA usage is increasing in is clinical anesthesia. A result of increasing LMA use is the desire to allow patients to breathe spontaneously whenever possible. Whether a patient is breathing spontaneously or not, assisted ventilation may be desirable.

For mechanical ventilation to be effective, the gases must be distributed to the lungs without loss of gases caused by LMA seal leaks. Additionally, the peak pressure in the airway must not exceed the seal pressure of the LMA. When the peak pressure does exceed the seal pressure, loss of gases will occur and gastric ventilation may also result.

PCV, for patients not breathing spontaneously, and PSV, for those patients who can breathe spontaneously, both avoid high peak airway pressures and compensate for additional gas leakage at the LMA seal.

Additional reading:

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Clinical Focus

by Datex-Ohmeda

LMA induced leaks

Why do I have to use such high flows with the LMA?

Guest Editor

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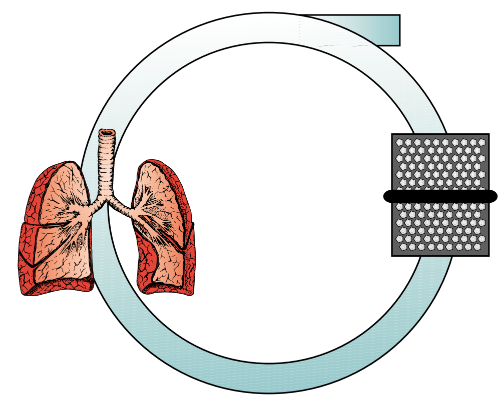

From the Breathing Circuit Series

LMA induced leaks

Over the years anesthesia machines have both greatly affected the practice of anesthesia and have, in return, been affected by the practice of anesthesia. This has recently come to the collective consciousness of anesthesia practitioners with respect to how the breathing circuit responds to leaks, and is the subject of this *Clinical Focus*, produced by the Department of Clinical Affairs. These leaks are not the traditional type, a loose connection or a faulty valve. These new leaks have been introduced by the use of laryngeal mask airways (LMAs) and other newer airway devices. In addition, the use of uncuffed endotracheal tubes combined with lower fresh gas flow (FGF) may produce a loss of breathing circuit gases. Irrespective of the cause, modern anesthesia machines must allow the user to identify developing leaks and allow the user to compensate for them.

What produces these leaks?

When a cuffed endotracheal tube is used to secure the patient's airway, a complete seal can be achieved when the cuff is inflated to provide even a minimal seal. Once achieved, irrespective of depth of anesthesia or degree of neuromuscular blockade (NMB) the seal will not decrease significantly. It may, especially if N_2O is used, actually increase as N_2O diffuses into the endotracheal cuff. It is for this reason that monitoring the cuff pressure has become increasingly popular over the past several years. LMAs, on the other hand, achieve a seal between the distal cuff and the hypopharynx. This seal is dependant upon the overall tone of the muscles surrounding the LMA. With increasing depth of inhalation anesthesia or with increasing NMB, the seal may decrease and result in leaks that were not experienced earlier in the anesthetic. These leaks, especially when they exceed the total amount of the FGF, may lead to a depletion of the gases within the manual ventilation bag or in the ventilator bellows.

What about mechanical ventilation?

Historically, Volume Control Ventilation (VCV) has been the most common ventilation mode utilized during anesthesia. VCV, while well suited to patients with cuffed endotracheal tubes, has two distinct disadvantages with respect to ventilation of patients with LMAs. The first is the peak pressure achieved during VCV. The second the inability of VCV to overcome the airway leaks common during LMA usage.

The peak pressure issue results from the constant flow rate VCV employs. This results in a rising airway pressure that peaks at the end of the inspiratory time (T_i). This peak pressure will frequently exacerbate any concomitant leaks around the LMA seal. Most research suggests that pressures greater than 20 cm H_2O are likely to result in increased leakage around the seal. While some clinicians have attempted to use pressure limited volume ventilation, the results have proven less than satisfactory.

Pressure ventilation, either Pressure Control Ventilation (PCV) or Pressure Support Ventilation (PSV), for patients who are able to breathe spontaneously, has proven quite successful in overcoming these two limitations in VCV.

Both PCV and PSV use an inspiratory flow pattern that decreases over the inspiratory time. This flow pattern is called a decelerating flow pattern. One of the results of decelerating flow is that gas distribution is optimized toward the beginning of T_i. As a result, it is common to see enhanced gas exchange during pressure ventilation when compared to similar ventilation in VCV. One may see that lower minute ventilations are required to achieve comparable end-tidal carbon-dioxide ($P_{et}CO_2$) levels.

Because of the enhanced gas distribution, PCV and PSV normally produce much lower airway pressures, frequently lower than 20 cm H_2O. With PSV the patient actually triggers the ventilations. This negative patient induced airway pressure lowers the peak pressure even more. With lower pressures and enhanced gas distribution, the tendency to exacerbate LMA seal leaks is minimized.

When LMA seal leaks are present, however, pressure ventilation is able to compensate for the majority of lost gases. In pressure ventilation the airway pressure is achieved and maintained irrespective of volume. This compensation may be able to address all but the largest LMA leaks.

To optimize ventilation when LMAs are used, it is vital to select the most appropriate size LMA and to inflate the cuff according to the manufacturer's recommendations.