Study of the adjustment of the Ambu laryngeal mask under magnetic resonance imaging

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Summary

Background: Our aim in this study was to analyze the adjustment of the laryngeal mask, Ambu AuraOnce, in pediatric patients during magnetic resonance imaging (MRI) and to look for a correlation between clinical parameters such as the sealing pressure and the ease of introduction with radiological parameters.

Methods: One-hundred and twenty-one pediatric patients from 4 months to 17 years who required a cranial MRI for other reasons were enrolled in the study. General anesthesia was induced with sevofluorane and no relaxant was used. Insertion attempts, sealing pressure, desaturation episodes and maintenance of anesthesia were recorded. Spontaneous ventilation was maintained throughout all procedures and no episodes of desaturation below 95% were seen. Patients without cough or pharyngeal pain were discharged after 1 h. Data were classified into three groups according to the size of the used laryngeal mask (group 1 for laryngeal mask number 1½; group 2 for laryngeal mask number 2, and group 3 for laryngeal mask number 2½). Sagittal MRI cuts were reviewed to calculate neck flexion, laryngeal mask position and its relationship with the trachea.

Results: First-attempt introduction rate of the laryngeal mask was 96%, and it was 100% after a second attempt. Sealing pressure was 22.1 ± 4.15 mmHg for group 1, 22.23 ± 3.94 for group 2, and 23.83 ± 3.28 for group 3. The angles between the laryngeal mask and the four first cervical vertebrae were calculated (group 1, 33.65 ± 8.05; group 2, 28.09 ± 6.65; group 3, 25.79 ± 4.26). Distances between trachea and proximal and distal cuffs were measured to evaluate proper fitting of the laryngeal mask. Anomalous placement seen on MRI, using distances from proximal and distal cuff to trachea, occurred in 23.5% in group 1, 10.9% in group 2, and 13.8% in group 3. We found no correlation between this anomalous position of the laryngeal mask and sealing pressure or ease of introduction.

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Conclusions: The Ambu AuraOnce can be regarded as a safe product for airway maintenance in pediatric patients. No relationship was found between radiological measurements and sealing pressures.

Introduction

The introduction of the classic laryngeal mask by Brain (1), in 1988, heralded a new method of airway management. Up to that point, the main alternative to the facemask had been the tracheal tube. This event marked the starting point of the development of new supraglottic devices.

Many studies have sought to identify reliable clinical parameters for assessing whether or not the device has been positioned correctly and to relate this to parameters such as sealing pressure and relative position of the epiglottis, to refine the way in which the device is used. Fiberoptic endoscopic visualization of the epiglottis via the laryngeal mask (2,3) revealed no correlation between the endoscopic views and those listed above. A radiological view of the laryngeal mask can show not only the position of the epiglottis, but also the relative position of the trachea and vocal cords.

The use of the AuraOnce (Ambu, Ølstykke, Denmark) laryngeal mask in managing adult patients has been assessed in previous studies, with satisfactory results (4).

We performed an observational, nonrandomized study to assess the clinical value of this new device in the pediatric setting and ways of checking radiologically that it is correctly positioned.

Methods

After informed consent had been obtained from all the patients’ parents or guardians, 121 ASA I and II patients were included in this study. These patients were admissions for magnetic resonance imaging (MRI) cranial studies under general anesthesia for other medical reasons. Any patient known to be suffering from deformity of the larynx was excluded from the study. Patients were continuously monitored for heart rate and pulse oximetry, as well as inhaled and exhaled gases.

Inhalational anesthesia was used for induction, with 100% oxygen and increments of sevofluorane until the corneal reflexes were lost. When introducing the laryngeal mask, a check was made to ensure that it was in the correct position, using both clinical criteria (emergence of a normal capnographic curve) and the presence of effective spontaneous ventilation with no chest retractions. The laryngeal mask size and cuff volume were chosen following the manufacturer’s recommendations. Insertion attempts were recorded, as were cases where it proved impossible to fit the device.

Once the mask had been fitted, the sealing pressure in the mask was assessed with the respiratory circuit closed. With a 5 l fresh gas flow, the pressure at which an audible escape developed in the pharyngeal region was recorded. If the capnographic reading was abnormal, if there were intercostal/suprasternal chest retractions, or if the sealing pressure was <15 mmHg, the mask was deemed to have been fitted incorrectly.

The studies were carried out using spontaneous ventilation and 50% FiO2 with 2% sevofluorane; SpO2 levels were above 95% at all times and P\textsubscript{E}CO\textsubscript{2} below 6.5 kPa (50 mmHg).

X-ray images were evaluated once the procedure had been completed. We used MRI images to assess the position of the laryngeal mask. On midline sagittal cuts, three lines were drawn and the angles between them were measured. The first line (Figure 1: line A) shows the relative position of the skull and passes from the anterior vertex of the upper jaw to the base of the hypophysis. The second line (Figure 1: line B) crosses the vertebral bodies of the first four cervical vertebrae and the third (Figure 1: line C) passes along the cuff of the laryngeal mask. We also calculated two distances from the sagittal view. Distance A measured the distance from the proximal cuff to the tracheal opening, and distance B measured from the distal cuff to trachea.

Results

The study included 121 patients (67 males and 54 females). One patient was excluded because of facial dysmorphia, which compromised ventilation.
The results were divided into three groups, depending on the size of laryngeal mask used.

Group 1 (laryngeal mask no. 1½) included 17 patients (10 females and seven males) aged 9 ± 7 months and weighing 7.64 ± 1.57 kg. Group 2 (laryngeal mask no. 2) included 73 patients (31 females and 42 males) aged 37 ± 16 months and weighing 13.9 ± 2.17 kg and group 3 (laryngeal mask no. 2½) included 31 patients (18 males and 13 females) aged 69 ± 18 months and weighing 22.6 ± 3.4 kg. A count was kept of the number of attempts made at introducing the laryngeal mask (see Table 1).

The sealing pressures obtained were >15 mmHg in 94.6% of cases. One patient in group 1 and five patients in group 2 had seal pressures <15 mmHg and were considered as an improper laryngeal mask fit, despite the fact that correct spontaneous ventilation and capnography were maintained. Masks were removed while the patients were still sedated. The patients were reassessed and discharged from the unit 1 h later. None had dysphagia or dysphonia.

With radiological views, masks were assessed as having been fitted incorrectly in cases where the proximal distance (Figure 2, distance A) was greater than the distal distance (Figure 2, distance B), or in those cases where the mask angle was 20% above or below the mean. Within group 1, it was deemed, on the basis of radiological evidence, that four out of the 17 masks (23.5%) had been fitted inappropriately, although no significant differences were seen in terms of sealing pressures. The figure for group 2 was eight out of 73 (10.9%), while the figure for group 3 was five out of 31 (16.12%). With reference

![Figure 1](image1.png)

**Figure 1**
MRI sagittal view. Distance A from trachea to proximal cuff. Distance B from trachea to distal cuff.

![Figure 2](image2.png)

**Figure 2**
Head sagittal view: line A passes through superior maxillary and hypophysis; line B crosses the body of the first cervical vertebrae; and line C crosses along the cuff of the laryngeal mask.

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LM, laryngeal mask.
\(^a\) 1st, 2nd, 3rd, 4th attempt.
to the angle at which the mask was fitted, the difference only exceeded 20% of the mean in one case in group 2.

The radiological study that was carried out provided us with important data. As we assessed the cervical angle, we noticed that this decreased with age, being greater at younger ages, whereas the angle formed by the line of the cervical column and that of the pituitary gland remained virtually constant. This change could justify a claim to the effect that masks of smaller sizes are more prone to being incorrectly positioned. This possibility reduced rapidly as the patients that we treated became older as well as with increasing device size.

Discussion

Since laryngeal masks were introduced into anaesthesiology practice, many articles have been published focusing on the clinical use of new supraglottic devices.

The structural differences featured in the Ambu laryngeal mask (the cuff and tube form a single item, with a 90° tube angle) make it easy to introduce the device into the child’s airway. In our study, we achieved a 95% first-attempt success index (115 cases out of 121), rising to 100% if we include a second attempt.

The sealing pressures that we obtained in our study show this device to be a good alternative to other types of supraglottic devices that are in use. It appears that the shape of the device may have some influence on the stability of the mask and may contribute to a better seal.

It is common practice to use sealing pressure to assess whether or not various devices have been positioned correctly and whether or not they can be relied upon to ensure safe mechanical ventilation. However, the results obtained for the same devices have varied widely, and there have been cases that suggested bronchoaspiration (5), where the devices being used showed a normal sealing pressure. We therefore need to take a fresh look at this point. Goldman et al. (6) studied the differences between two supraglottic devices with the head in different positions. Sealing pressures were found that varied by more than 50% between maximum extension and maximum flexion of the neck. This could be one of the reasons why sealing pressures found in various studies ranged between 23 and 32 cmH2O for a single device (7–10).

Thus, we may have to rethink the idea of using sealing pressure as the sole indicator of the effectiveness of a device. Inagawa et al. (11) carried out a fiberoptic endoscopic study on the correct positioning of laryngeal masks; they found no correlation between the endoscopic findings and sealing pressures. Parameters such as ease of introduction, onset of posterior pharyngeal pain or bleeding also need to be evaluated jointly.

Radiological checks are rarely carried out to ensure that supraglottic devices have been positioned correctly. In our study, the laryngeal mask was visualized by assessing the imprint that it left behind, both at the base of the tongue and in the esophagus. The angles of the lowermost cervical vertebrae and the pituitary gland were evaluated to assess the extension of the cervical spine and of the head.

The angle of the mask in relation to the cervical spinal column appears to be fairly constant for larger masks, increasing steadily as we reduced the size of the mask. This could have something to do with the increase in poorly positioned laryngeal masks evaluated radiologically. There appears to be no clinical correlation for this alteration.

Use of the Ambu laryngeal mask (AuraOnce) to manage the airway in the pediatric setting appears to be safe, swift and easy. The sealing pressures obtained are sufficient to provide safe anesthetic conditions in majority of the patients.

Our study failed to show any correlation between variations in the way in which the laryngeal mask was fitted, with radiological views and either the sealing pressure obtained, or proper patient ventilation.

The absence of clinical predictive values, such as sealing pressure, from devices that do not fit properly to those that do, makes it difficult to estimate the relative position of the vocal cords in relation to the laryngeal mask. This fact may explain why some studies using fiberoptic views have a low rate of success in viewing the trachea.

We need more studies to compare different supraglottic devices using radiological imaging.

References


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