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Original Article

A Comparative Study between Standard Weight-Based Technique and Pinna Size-Based New Technique for Classic Laryngeal Mask Airway Size Selection in Pediatric Population

Uma Kamath[1], Shamala Dinkar Yashod[1], Madhulata Garasia[2]

[1]Assistant Professor, Department of Anesthesia, King Edward Memorial Hospital and Seth Gordhandas Sunderdas Medical College, Mumbai, Maharashtra, India, [2]Professor, Department of Anesthesia, King Edward Memorial Hospital and Seth Gordhandas Sunderdas Medical College, Mumbai, Maharashtra, India

Abstract

Introduction: The laryngeal mask airway (LMA) is a non-invasive supraglottic airway device designed to maintain the airway, which sits outside of and creates a seal around the larynx. In clinical practice, the most commonly used method for size estimation is the weight-based method. However, this may not be suitable due to lack of standardization in pediatric patients, emergencies, overweight, etc. Therefore, this study was undertaken to evaluate the efficacy of the new pinna size-based method for the estimation of LMA size.

Materials and Methods: A total of 100 pediatric patients, aged under 15 years, undergoing ambulatory surgeries, belonging to American society of anesthesiologists (ASA) Grades I and II, were randomly divided into two groups: Weight-based and Pinna size-based estimation. Parameters such as number of attempts and change of size required were monitored.

Results: LMAs were inserted in both the groups in the first attempt. However, LMAs needed to be exchanged in 2% of cases in Group A and in 16% of cases in Group B.

Conclusion: Pinna size-based estimation for the size of LMA is a convenient and feasible alternative to the traditional weight-based estimation.

Key words: Auricle size, Children, Laryngeal mask airway, Pinna size, Weight-based estimation

INTRODUCTION

The laryngeal mask airway (LMA) is a supraglottic airway device designed to maintain the airway, which sits outside of and creates a seal around the larynx. It is relatively non-invasive as compared to endotracheal intubation and in scenarios where endotracheal intubation is not mandatory, LMA has emerged as a formidable choice over endotracheal intubation.[1] Compared with the face mask, the LMA allows for a more "hands-free approach" to airway management.[2] In difficult airway management, LMA can bypass obstruction at supraglottic level and allow rescue oxygenation and ventilation, provided that mouth opening is sufficient.[3]

The LMA Classic is a first-generation supraglottic airway device, with the largest evidence base for efficacy and safety, and is considered the benchmark against which newer LMAs are judged.[1]

For proper use of the LMA, the main criteria are selection of appropriate size, the method of insertion, and inflation of the cuff. The LMA is available in different sizes ranging from 1 to 6. Sizes over 4 are used for the adult population, with LMA size 4 being appropriate for an adult female and size 5 for an adult male with a body weight not exceeding

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Corresponding Author: Dr. Shamala Dinkar Yashod, 7, Dhavalgiri, Veer Savarkar Nagar, Opposite Sai Baba Mandir, Vasai (West), Palghar, Maharashtra - 401 202, India.

100 kg. Sizes of 3 or less are for the pediatric population. However, the selection of the correct size in children remains difficult due to a lack of standardization of weight-based and age-based methods for sizing. In clinical practice, the most commonly used method for size estimation is the weight-based method.[4]

However, this may not be suitable in many patients due to the wide range for each category of weight. The development of the oropharyngeal cavity and the tissues surrounding the upper airway (bone and soft tissues) is linearly related to the age and the height independently of the sex or weight of a child.[5] An endotracheal tube size is said to be approximately equal to the size of the little finger of a child. Although this estimation may be difficult and unreliable, it provides a rough approximation of the size of the tube required. No similar method exists for rough estimation of the required LMA size.

LMA in Children

The LMA has formed a very important part of the airway management of adults and, now, children. Early trials of the pediatric LMA note that the design was a scaled-down version of the adult LMA and not anatomically designed for children. Moreover, it was clear that the range of available sizes was inadequate. Since then, improvements in the design and availability of suitable sizes (from the smallest size 1 for wt. 0–5 kg to the older child, size 3 of weight 50 kg), together with favorable clinical experiences have led to the increasing use of LMA in children. As the LMA can be inserted easily without the use of muscle relaxants and provides a secure airway, it is increasingly used where a face mask was previously used. It is seen to replace the tracheal tube in a lot of situations as its use with controlled ventilation has also become accepted practice.

Therefore, this study was undertaken to assess the feasibility of using external ear (pinna) size of the child, as a proxy for the required size of LMA and compare the results with the standard weight-based technique.

MATERIALS AND METHODS

This prospective, randomized study was undertaken after approval from the Institutional Ethics Committee. A total of 100 patients in the age group of 1–15 years undergoing ambulatory surgeries such as circumcision, open herniotomies, anal dilatation, urethral dilatation, laparoscopic appendicectomy, laparoscopic hernia repair, diagnostic laparoscopy, belonging to American society of anesthesiologists (ASA) Grades I and II, and whose parents willing and able to understand the risk of surgery and anesthesia were included in the study. Patients belonging to ASA Grade II or higher, ex-preterm infants, emergency cases, and patients with a history of hiatus hernia and decreased pulmonary or chest wall compliance, patients with a history of obstructive sleep apnea, asthma, congenital heart disease, obesity, mental retardation, or recent history of respiratory tract infection were excluded from the study. A written informed consent was obtained from the parent. The patients were randomly divided into two groups:

- Group A – Weight-based LMA selection
- Group B – Pinna size-based LMA selection

Pre-anesthetic checkup was done and routine investigations performed. Patients were kept overnight fasting. The external ear was measured with a ruler in the vertical and horizontal dimensions. If the external ear fell between two sizes of LMA, larger size was considered. LMAs one size larger and one size smaller were available for exchange if the approximation was incorrect. I.V line was secured. Premedication was given: Midazolam 0.03 mg/kg i.v, ketamine 0.5 mg/kg i.v, and glycopyrrolate 4 mg/kg i.v. After confirming adequate baseline saturation, the child was pre-oxygenated. Induction was done with propofol 2 mg/kg, fentanyl 2 mg/kg i.v, and muscle relaxant in the form of atracurium 0.5 mg/kg i.v. Airway was secured with the selected classic LMA. Correct placement of device was confirmed. Patients <20 kg were induced on Jackson Rees circuit and patients >20 kg were induced on closed circuit. After induction, patients were maintained on closed circuit with oxygen, air, and desflurane (3–8%) or oxygen, air, and sevoflurane (1–3%). All patients received air:oxygen (50:50). Ventilation was controlled to maintain normocapnia. End-tidal concentration of each anesthetic combination (volatile drug and air) was maintained at approximately 1.3 minimum alveolar anesthetic concentration (MAC) until the end of surgery, when spontaneous recovery of neuromuscular function was confirmed and all anesthetics were discontinued. Ventilation was continued at the same fresh gas flow until the return of a cough reflex. Each patient's LMA was removed when there were a cough and gag reflex, grimace, and purposeful movements.

Statistical Analysis

Analysis was done by SPSS. The data were analyzed using Chi-square test. $P < 0.05$ was considered to be statistically significant.

RESULTS

Both the groups were comparable in terms of demographic variables and physical characteristics. The gender-wise distribution of Groups A and B is shown in Table 1. However, the difference was statistically not significant ($P = 0.401$).

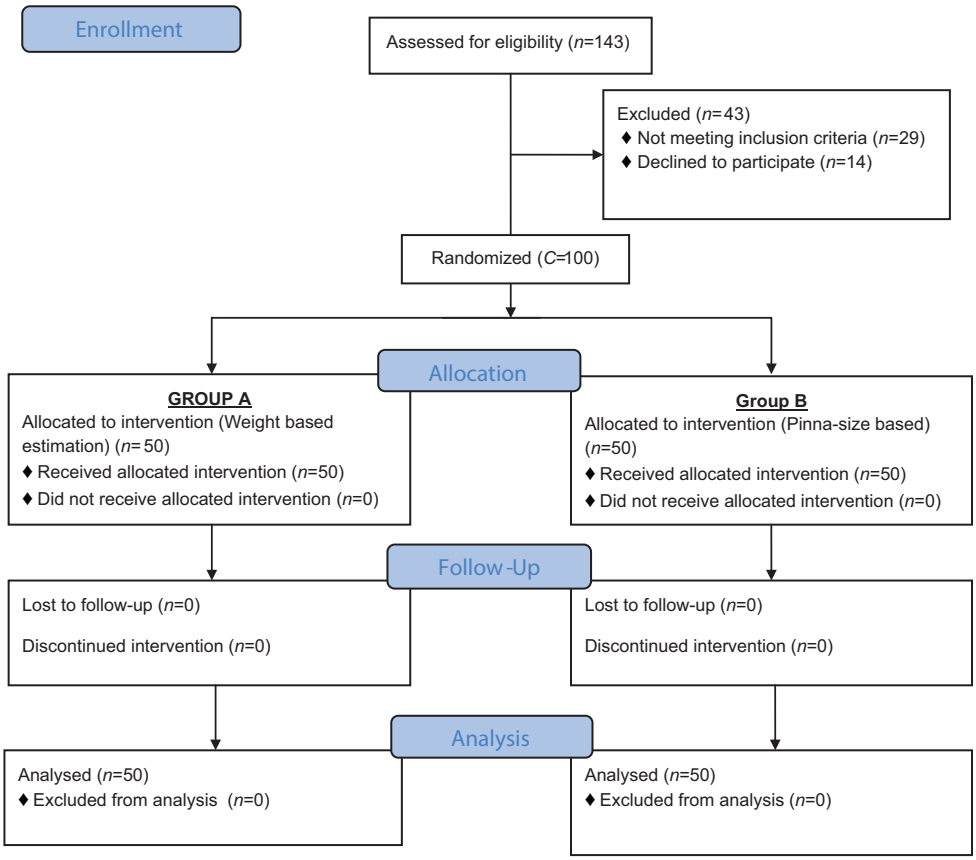

Table 1: Gender-wise distribution of the study population in Groups A and B

Parameter	Group A (%)	Group B (%)	*P*-value	Statistical significance
Male	44 (88)	41 (82)	0.401	Not significant
Female	6 (12)	9 (18)		

The requirement for changing the LMA tube due to incorrect estimation of size was greater in Group B than in Group A [Table 2], and this difference was statistically significant ($P = 0.014$).

DISCUSSION

Before the introduction of LMA Classic by Dr. Brain, the choices of airway management were either face mask or tracheal tube. In the past 25 years with the development of various supraglottic airway devices, the armamentarium for airway management has increased. However, for the proper use of these airway devices, size selection is of utmost importance. Insertion of correct size of airway is required for its appropriate use. At present, weight-based method is commonly used worldwide for Classic laryngeal mask airway (CLMA) size selection. The best evidence requires a randomized controlled trial comparing a new method against the established one, properly powered to detect clinically relevant differences in clinically important outcomes. Such studies in children are very rare.

LMA Classic is a first-generation supraglottic airway device, whose usage in children is well established in both routine and difficult airway management. It has the largest evidence base for efficacy and safety and is the benchmark by which other supraglottic airway devices are evaluated.[1]

The LMA is used widely by anesthesiologists for a variety of elective cases and is part of the difficult airway algorithm of the ASA.[6] It is now a standard device in many ambulances and emergency departments and estimating the correct size, especially for children, can be beneficial.

Therefore, this study was conducted to assess the feasibility of using pinna/auricle size for the assessment of size of LMA in children, as an alternative to the traditional weight-based assessment.

Both the groups were similar in terms of demographic variables and physical characteristics.

All the cases were successfully intubated in the first attempt in both the groups. However, the estimation of the LMA size based on pinna size was found to be accurate in 84% of the cases, while the traditional weight-based method was

Table 2: Group-wise distribution of the requirement of changing of LMA in Groups A and B

Parameter	Group A	Group B	*P*-value	Statistical significance
Change of LMA required	1 (2)	8 (16)	0.014	Significant
Change of LMA not required	49 (98)	42 (84)		

found to be accurate in 98% of the cases. Thus, in the study, the pinna-based method was found to be feasible with 84% success rate. It may be used as an alternative to the traditional weight-based method, especially in cases of overweight patients and emergencies, where the weight-based estimation may be erroneous or comparatively time consuming.

The results of a number of attempts, success rate for correct estimation of the size of LMA by pinna size-based method, and conclusions were similar to the following studies:

- According to the study by Haliloglu *et al.*,[7] auricle size-based Proseal laryngeal mask airway (PLMA) selection showed good correlation with the body weight-based method, with a success rate of 90% in the first attempt. They also concluded that the weight-based method tended to overestimate the size of PLMA
- According to the study by Zahoor *et al.*,[8] success rate with pinna size method was 93%. For 11 of the 14 failures, the ear size-based estimation led to an underestimation of the required LMA size and a half-size larger LMA was finally chosen. Tonsillar hypertrophy and light anesthesia were the other causes of failure. Hence, this method could be used as an additive method to the existing standard methods
- In the study by Ravi *et al.*,[9] the first attempt success in PLMA placement in pinna group was found to be 93.07%. They successfully concluded that pinna-based size selection of PLMA can be used as an alternative method to weight-based size selection in age groups between 6 months and 12 years of age
- Gallart *et al.*[10] compared the traditional weight-based method for the estimation of size of LMA with a novel method using combined width of patient's index, middle, and ring fingers, as the best estimate for size of LMA. They argued that a new valid and practical approach for the estimation of LMA size in children is required as an alternative in the cases where the weight of the patient is unknown or in emergency situations or in cases where weight is borderline and accurate estimation of LMA size may not be possible. They found "excellent agreement" between both the methods, with disagreement of only one size in 22% of cases. In such patients, the weight was a borderline value that would indicate a change in the size of the LMA using the classic method
- In the study by Weng *et al.*,[11] a comparison was done traditional weight-based estimation and the new thyromental distance-based estimation. They found that the weight-based technique tended to choose an oversized LMA for overweight patients. This may lead to many foreseeable adverse consequences such as increased number of attempts for the placement of LMA, inadvertent injury to the soft tissues of oral cavity and throat, leakage, and insufficient ventilation. They found thyromental distance-based method to be better in terms of positive pressure ventilation, facilitating device placement, and reliable pharyngeal sealing.

Limitations

The study was limited by the OPD attendance of the pediatric patients undergoing ambulatory surgeries. Therefore, the results may not be generalized.

CONCLUSION

Thus, it is be effectively concluded from the study that pinna size-based estimation for the size of LMA required in children can be considered as a convenient alternative to the traditional weight-based estimation and needs to be explored further.

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