ALTERNATE METHOD FOR DETERMINING THE SIZE OF CLASSIC LARYNGEAL MASK AIRWAY (CLMA) IN CHILDREN. A PROSPECTIVE OBSERVATIONAL STUDY

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Abstract

Introduction: The classic laryngeal mask airway (cLMA) is a widely used supraglottic airway device in pediatric anesthesia. Accurate size selection is crucial to ensure effective ventilation and reduce complications. Traditionally, cLMA size is determined using weight-based guidelines. However, in emergency or low-resource settings, estimating weight may be challenging, prompting the need for alternative sizing methods.

Objective: To determine an agreement between weight-based and Auricle-size methods of selecting the correct size of cLMA in children undergoing genitourinary surgery.

Materials and Method: The study was a prospective observational study of 100 children ranging in age from 1 to 15 years at SIUT Karachi, Department of Anesthesiology, between June and November 2024. The size of cLMA based on auricle size and based on weight was noted. The Kappa statistics were used to measure whether the methods agreed or not.

Results: There was a moderately high agreement (Kappa = 0.616, p = 0.0005). Subgroup analyses increased the consistency of findings in the age, weight, and gender.

Conclusion: Auricle-size-based estimation is a reliable and practical alternative to weight-based cLMA size selection in pediatric patients.

Keywords: cLMA, supraglottic airway, pediatric anesthesia, auricle size, weight-based method, airway management.

INTRODUCTION

The classic laryngeal mask airway (cLMA) is a reusable supraglottic airway equipment that was formerly created to be used in the operating theatre when the patient under general anesthesia requires the airway to be secured. In the long run, it has been increasingly used in emergency and critical care, particularly among children, due to its simple application and little expertise is needed as far as direct laryngoscopy is concerned (1). The limited trauma and complications that the cLMA entails for the patient make it a dependable technology within pediatric anesthesiology (2,3). Though this has its benefits, proper determination of cLMA size is crucial in ensuring maximum ventilation and the least problems. Classically, the choice of cLMA size relies on the body weight of a patient, which manufacturers and clinical guidelines promote (4). Nevertheless, the pediatric patient poses special problems because of the differences in growth patterns and body composition, particularly in those

who are underweight or overweight, in whom weight as a measure is not well correlated with upper airway size (5).

Moreover, during emergencies, the weight of a child can be missing or poorly approximated, and this requires the presence of another straightforward and quick way of selecting the size (6). Children and adults have different anatomical and physiological differences that further make cLMA sizing more complex. Compared to adults, pediatric airways are more anterior and have proportionally larger tongues and narrower subglottic spaces, a condition that aggravates the risk of airway obstruction, poor sealing, and ineffective insertion in case a wrong size is selected (7). An oversized fit can lead to higher oropharyngeal leak pressure and aspiration risk in addition to ordinary overinflation or anchoring of the nerves (8). This emphasizes the significance of fit under the decade of decreasing the perioperative mortality and morbidity rate and enhancing the effect of petite anesthesia (9,10).

Recently, other anatomical points have been considered as possible indicators of proper cLMA size. The other approach, which would be to use the size of the auricle (external ear) as a proxy, assumes that craniofacial development, such as the size of the ear, correlates with upper airway development (11). Arens et al. proceeded to prove that the linear development of the auricle reflects the anatomical alterations in the upper airway, making it a possible non-invasive and time-efficient tool for estimating the size of cLMA (12). Earlier comparisons of these two methods (auricle-based vs. weight-based) assessed by Western researchers have recorded moderate agreements with kappa values of 0.56 and 0.52, respectively (13,14). Nonetheless, it is unclear whether the evidence can be used to represent Asian groups due to the ethnic variation of anthropometry and growth perceptions (15).

The auricle-size approach holds some potential in this regard and, as such, would be appropriate in low-resource conditions and emergency situations where the patient may not be able to be weighed. Moreover, the simplicity of the method negates the possibility of specialized equipment and reduces the cognitive load on healthcare providers, who have to work under pressure (16). The versatility of the cLMA in a wide range of clinical practices, including its use in neonatal resuscitation, endoscopy, and trauma calls- makes it essential to have an effective method of estimating the size of the airway to facilitate quick and safe airway management (17,18). Airway management is critical in pediatric populations undergoing elective surgeries, such as genitourinary procedures. Supraglottic airways such as the cLMA have the advantage of a lower complication rate than endotracheal intubation, plus the ability to be used with spontaneous ventilation (19). However, there is a dearth of evidence from the local population about the best way to do sizing despite the wide practice.

Considering this discrepancy, this prospective observational study would be focused on identifying the degree of concurrence between the use of an auricle-based and the use of a weight-based method of choosing cLMA sizes in children aged between 1 and 15 years undergoing genitourinary surgery at a tertiary care hospital in Pakistan. The research takes advantage of anthropometric data characteristic of the local community, covering the local demand for clinical data. This study aims to prove the auricle-size technique as a putative option of excellent and straightforward application in daily pediatric anesthetic practice by comparing the relationship between the auricle size and the most suitable cLMA size. The possible consequences of this study are diverse. Clinically, the use of size based on auricles could enhance the rate and precision of airway management, especially in cases of emergencies and also those cases in which there is a shortage of resources. Training-wise, it provides a less complicated, more instinctive solution for junior anesthetists and paramedics and skills acquisition. Moreover, this approach can be associated with worldwide efforts to streamline the work of balancing the airways in children by using invasive, inexpensive measures.

Objective: To compare the consistency between weight- and auricle-size-based procedures of selecting the correct size of classic laryngeal mask airway (cLMA) in children undergoing genitourinary surgery.

MATERIALS AND METHODS
Design: Prospective Observational Study.

Study setting: The study was conducted at the Department of Anesthesiology, Sindh Institute of Urology and Transplant (SIUT), Karachi, Pakistan.

Duration: The study spanned six months, from 01-June-2024 to 30-November-2024.

Inclusion criteria: Children aged between 1 and 15 years, either gender, who were scheduled to have elective genitourinary procedures that would use general anesthetic and where the use of classic laryngeal mask airway (cLMA) was indicated, were included. Patients with an American Society of Anesthesiologists (ASA) physical status classification I and II could participate only. Parents or legal guardians were informed before they were included with consent.

Exclusion Criteria: Children with congenital ear anomalies, oropharyngeal lesions, a musculoskeletal disorder, gastroesophageal reflux, or at a higher risk of aspiration or with a known/suspected upper airway anatomical abnormality were excluded. Also, subjects with a previous history of respiratory tract infection within the past four weeks were not eligible for the study.

Methods

A total of 100 children who met the inclusion criteria were recruited after approval was granted by an ethics committee, and informed parental consent was obtained using a non-probability consecutive sampling method. The children had been admitted and maintained NPO on the day before the surgery, according to the hospital policy. General monitoring was implemented in the operating theatre, and anesthesia was induced using the usual hospital procedures. The designated anesthetist measured the dimension of the auricle (width linear width) before placement of the classic laryngeal mask airway (cLMA) to find out the size based on the auricle. The weight of the kids was also noted down to choose the size based on the standard size, which is according to the weight. Nevertheless, just the weight-based size was applied in the insertion procedure itself. Auricule-based size determination was made on the size of the auricles using a prepared study proforma and also by weight-base size determination. Information regarding age, sex, ASA grade, height, and weight was also recorded. Later, the concordance between the two sizing methods was analyzed with the help of kappa statistics.

RESULTS

The study involved 100 children with planned cLMA who were to undergo general anesthesia and perform genitourinary surgeries. The age of the participants had a mean of 9.72 ± 3.60 years, with a one-year age range observed between 1 and 15 years. The average weight was 31.70 +/- 12.02 kg, and the average height was 132.82 +/- 19.24 cm. The gender ratio was somewhat predominantly male, with 53% boys and 47% girls. Concerning ASA in classification, 66 percent of the children were ASA I, and the rest were ASA II (34 percent).

Table 1: Descriptive Statistics of Children

Variable	Mean ± SD	Median	IQR
Age (years)	9.72 ± 3.60	9	4
Weight (kg)	31.70 ± 12.02	28.5	14
Height (cm)	132.82 ± 19.24	135	28

Graph 1: Gender Distribution of Children (n=100)
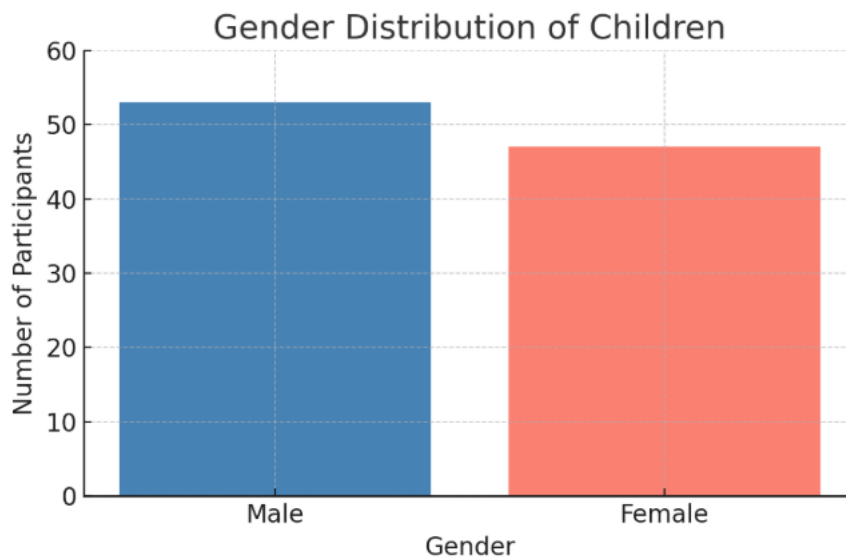
The agreement between weight-based and auricle-sized-based methods for determining cLMA size was statistically significant and moderately high overall. The Kappa coefficient was 0.616 (p = 0.0005), suggesting substantial agreement between the two sizing methods.

Table 2: Agreement Between Weight-Based and Auricle-Size-Based Methods for cLMA Size Selection

Weight-Based Size	Auricle-Based Sizes	Total
	1.5	2.0
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1.5	4	1
2.0	2	5
2.5	5	6
3.0	0	0
4.0	0	0
Total	11	12

Kappa = 0.616; p = 0.0005

Stratification was performed to assess whether age, gender, weight, or height affected the level of agreement. Subgroup analysis revealed moderate to substantial agreement in all categories, reinforcing the reliability of auricle-size-based selection across different demographics.

Table 3: Stratified Kappa Agreement Based on Key Variables

Variable	Group	Kappa Value	p-value
Age	≤10 years	0.423	0.0005
	>10 years	0.637	0.0005
Gender	Male	0.649	0.0005
	Female	0.571	0.0005
Weight	<30 kg	0.35	0.001
	≥30 kg	0.65	0.0005
Height	≤135 cm	0.373	0.0005
	>135 cm	0.603	0.0005

The research demonstrates that the auricle-based approach consistently displays a stable level of performance across all pediatric subgroups, particularly in children aged over 10 years with high body weight and taller height. Concurrence was low in younger, lighter, or shorter children and may be due to anatomical differences present in infancy. In general, this prospective observational study helps to confirm that auricle size can be an effective and quite realistic indicator of correct cLMA in children, in particular, in situations where actual weight is unavailable or is not viable.

DISCUSSION

The classic laryngeal mask airway (cLMA) has developed a reputation as a trustworthy supraglottic device for managing the child's airway. It is also the most common in elective operations, as it is easy to insert, minimally invasive, and has a positive safety record. Nonetheless, good size selection is also an essential part of its correct application. The study aimed to assess how well an alternative technique of sizing cLMA using the measurement of recurrent laryngeal nerve (auricle) compares to the conventional tried and tested weight-based method of sizing cLMA in children undergoing genitourinary surgeries. Statistically significant and moderate high agreement between auricle-size-based and weight-based methods was demonstrated in the results, with the overall Kappa value of 0.616 (p = 0.0005). This is similar to previously done studies in Western countries, which showed an approximate equivalence between the two, agreeing with Kappa of 0.52 to 0.56 (13,14).

The study appears to be one of the first datasets in the South Asian population, whose pediatric anthropometry highly differs in contrast to the Western counterparts (15). Thus, the results provide the local color to the evidence base. The size of the auricle has become a promising and non-invasive measure of the development of the upper airway. The growth of auricular muscles and other structures is closely directly correlated well linearly with the development of benign soft tissues in the head and neck, such as the pharynx, as proposed in the study of anatomy (12). That the auricle is readily available and its size does not vary greatly makes it feasible as a landmark to assess the airway, particularly in high-volume or strained environments when weighing machines might not be accessible or when they are highly variable (10).

The bearing of this advantage is especially important in stress cases when it is not always known how much weight there is and the estimation methods are not correct (11). The sole use of weight in these cases may cause under- or oversizing the cLMA and cause complications such as inadequate ventilation, excessive oropharyngeal leak pressures da, damage to the pharyngeal structures, or a complete breakdown of the airway device (8,9). Therefore, the clinical application of auricle-based sizing as an add-on or alternative to weight-based measurement was consistent with the study. Among the findings of the stratified data, it was evident that the level of agreement between methods was found to be higher in children over the age of 10 years (Kappa = 0.637) as compared to those whose age is 10 years or less (Kappa = 0.423). The same tendency was found in the case of weight and height: children over 30 kg or more than 135 cm tall showed greater values of agreement (Kappa = 0.65 and 0.603, respectively).

These findings suggest that, possibly due to the proportional development of anatomy, estimation using the auricle may be more reliable with age in children. The converse is always true in that younger age groups with unusual growth rates (e.g., undernourished or overweight) may need to be treated with caution when using auricle-based estimates. The gender analysis indicated a slight increment in the agreement between males (Kappa = 0.649) and females (Kappa = 0.571), but both ratios still maintain moderate to substantial agreements. These differences may be due to differences in the rate of craniofacial growth between boys and girls at an early age and puberty, which needs to be further investigated in larger multi-centric studies. Some past researchers have tried to determine other anatomical surfaces to estimate the size of LMA. Zahoor et al. were the first to suggest the mini-model with three fingers as one of the measures of airway device size estimation (10).

Ravi et al. (9) have demonstrated that the pinna-based method is effective in Indian populations, including pediatrics. Haliloglu et al. (13) also depicted a Kappa value of 0.62 using sizing with the auricle in children up to 30 kg, indicating high agreement. All these findings reinforce the hypothesis

that auricle-based estimation may be a good and reproducible strategy in various populations. Procedurally, measuring auricle size needs little training, does not need any special equipment, and can even be included in the capacity of junior anesthetists, paramedical workers, or emergency medical responders. Although this study is promising, it has some limitations. First, the sample was restrictive since it was focused on children with genitourinary procedure entirely, and results should not be applied to children with craniofacial anomalies, airway malformations, or those with thoracic and neurosurgery in which variations may occur in the airways. Second, the agreement between the two methods was measured, but not clinical outcomes like oropharyngeal leak pressure, insertion time, or number of insertion attempts, which would provide a deeper understanding of the functional superiority of either method.

Moreover, the results do not supplant the method of weight but merely serve as additional support to estimate using the auricle-based method, especially where measurement of weight is either impossible or not available. Weight-based selection is standard in routine elective surgeries in which there is sufficient preparation time and equipment. Nonetheless, during emergencies, prehospital, or low-resource conditions, estimation using the caduceus may act as a prompt, viable alternative in the auricle. In the future, it is necessary to conduct a larger multi-center study involving more participants and more diverse surgical populations to confirm the findings. Considering outcome-related evaluations like airway sealing effectiveness, ventilation quality, and complication rates would give a broader assessment. Moreover, integration of digital technologies such as mobile apps or scanning the auricles with the help of AI to increase measurement accuracy and standardization in further practice can be done.

CONCLUSION

This prospective observational study aimed to determine the level of agreement between the weight-based and auricle-size-based procedures with regard to the determination of the right size of classic laryngeal mask airway (cLMA) amongst children with genitourinary surgery. The results were indicative of a statistically and moderately high correlation between the two procedures and a value of Kappa of 0.616 that indicated that the auricle-based estimation technique was a good alternative to conventional weight-based sizing. Subgroup analysis also showed the same pattern with respect to age, gender, weight, and height categories. The advantages of utilizing the auricle-size method are practical, especially during an emergency or low-resource scenario, where precise weight measurements can be complex and challenging. Although the weight-based approach is considered to be the gold standard, auricle-based estimation can be used as a helpful complement as it makes airway management more flexible and efficient. Future research with the inclusion of clinical outcome measures and different population sizes is suggested to confirm and improve this method. Altogether, predicting cLMA size based on the auricle can potentially aid in enhanced patient safety and aesthetical treatment in pediatric subjects.

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