Appropriate Size of Laryngeal Mask Airway in Thai Children: Is It Age or Weight that Better Correlated?

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Background: *Clinicians are divided regarding laryngeal mask airway (LMA) size selection for pediatric patients, primarily whether age or body weight is an appropriate predictor.*
Objective: *Determine if body weight and/or age are reliable predictors in LMA size selection in Thai children.*
Material and Method: *Retrospective review of patient medical records was conducted between October 1, 2012 and December 31, 2013. Seven hundred forty one patients, aged 0 to 8 years, were evaluated for the present study. Age and weight correlation for LMA size selection was determined. Appropriate LMA size was identified by successful LMA insertion after induction of anesthesia.*
Results: *Our findings indicate that size 1 LMA for patients weighing less than 7 kilograms, size 1.5 LMA for patients weighing 7 to 11 kilograms, size 2 LMA for patients weighing 11 to 17 kilograms, and size 2.5 LMA for patients weighing 15 to 28 kilograms is appropriate. There was poor correlation between children's age and LMA size.*
Conclusion: *LMA size selection should be based on patient's weight. Our findings revealed applicable and specific weight range for LMA selection in Thai pediatric patients.*

Keywords: *Laryngeal mask airway, Size, Children, Age, Weight*

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Laryngeal mask airway (LMA) was invented in 1981 as a low-invasive supraglottic airway device (SAD)[1,2]. Using this device, ventilation can be established without increasing the risk of aspiration or regurgitation[2]. LMA has become popular for various purposes, including pre-hospital emergency care and a variety of surgical procedures. Since LMA is preferred by anesthesiologists facing difficult airway approach, appropriate size selection is crucial.

Pharyngeal anatomy of pediatric patients is different from that of adults. Infants have larger occiput, relatively large tongue, floppy epiglottis, higher and more anterior larynx, and enlarged tonsils, making endotracheal intubation sometimes difficult[3]. As a result, LMA has become popular among anesthesiologists seeking an alternative to endotracheal intubation. However, LMA insertion is not always feasible in pediatric patients, as growth and physical development influence LMA size selection[4]. LMA manufacturers and some groups recommend either body weight or age as a criterion for LMA selection in infants and children[5] (Table 1).

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Manufacturer instructions' for infants are based on the anatomical structure of a Caucasian adult[1]. The proper LMA size application in Asian is still unknown. As a consequence, there is no actual recommendation for LMA size usage in Thai children.

The objective of the present study was to identify simple parameters for selecting appropriate LMA size in Thai children by correlating patient's age and weight with success rate of LMA insertion. The secondary objective was to determine the range of age and weight for LMA size selection.

Material and Method

After receiving approval from the Siriraj Institutional Review Board (SIRB) (Number Si 693/2013), a retrospective review of patient medical

Table 1. Weight and age reference guide: (a) age range reference guide[5], (b) weight reference guide[6]

LMA size	Weight (kg)	Age (month)
1	<5	0-5
1.5	5-10	5-12
2	10-20	12-60
2.5	20-30	60-120

LMA = laryngeal mask airway

records was conducted between October 1, 2012 and December 31, 2013.

Seven hundred forty one patients aged 0 to 8 years whom underwent anesthesia using LMA were evaluated. Exclusion criteria were patients with history of unsuccessful LMA insertion, airway or anesthetic complications, and incomplete case record forms. Patient demographic data, age, gender, body weight, height, underlying diseases, ASA classification, recent upper respiratory tract status, type of operation and position, choice of anesthesia and airway devices, intraoperative airway related events, and total anesthetic time were recorded.

Successful selection of proper LMA size was characterized by a successful LMA insertion by experienced anesthetic personnel when patient in the supine position. Definition of successful insertion was LMA is defined as an insertion attempt that results in an adequate ventilation without or with minimal leakage, as confirmed by end-tidal capnography. Leakage, obstruction, and/or patients' intolerance were considered failure of LMA insertion[8].

Statistical analysis

The primary objective of the present study was to evaluate the relationship between LMA size and patients' age or weight. Given that there was no previous study to be referred to for calculation of sample size. So age or weight correlated well to LMA size, we expected a high correlation coefficient at 0.5 and 0.7 respectively with 95% confidence interval (CI) and error 0.1. The sample size of at least 175 subjects was calculated for correlation coefficient at 0.5. Seven hundred forty-one case records were finally included in the study.

Clinical characteristics of patients were analyzed using descriptive statistics. Pearson's correlation and Spearman's rank correlation were used to identify correlations between LMA size and age and weight. Comparison of correlation between LMA size and body weight and age was performed using Z-test. A p-value <0.05 was considered to be statistically significant.

Results

There were 469 male (63.3%) and 272 female patients (36.7%) aged 0 to 96 months, with 70% of them in healthy condition. Additional patient and clinical data were presented in Table 2. LMA was mainly used in ophthalmic procedures. Size 2 LMA was the most frequently used size (64.1%).

LMA and body weight

Four patients were excluded from analysis due to extreme deviation, one 10 kg-patient required LMA size 1, one 12 kg-patient required LMA size 1.55, one 5 kg-patient, and one 24 kg-patient both required LMA size 2. Table 3 describes the correlation between LMA size and patient weight in 737 patients. In each group of LMA size, body weight distribution were tested and found normal distribution in group LMA number 1.5 and 2. Correlation coefficient by Spearman's rank correlation test was 0.746. Recommended weight range for LMA selection in our study was derived from mean ± standard deviation (SD). Body weight was found to be a good predictor for determination of LMA size.

LMA and age

One 11-month-old patient requiring LMA size 1 was excluded from this analysis. Data from 740 cases were presented in Table 4. In each group of LMA size, age distribution were tested and found normal distribution in group LMA number 1.5 and 2. Correlation coefficient by Spearman's rank correlation test was 0.606. Age was also found to be a predictor of LMA size, but less effective than body weight.

Table 2. Demographic data and surgical characteristics in patients with LMA

Characteristic factors	Total (n = 741 cases)
Sex	
Male	469 (63.3%)
Female	272 (36.7%)
Age (months), mean ± SD	34.27±22.28
Weight (kg), mean ± SD	14.01±4.95
ASA	
Class I	519 (70.0%)
Class II	185 (25.0%)
Class III	37 (5.0%)
Department	
Ophthalmology	238 (32.1%)
Orthopedics	154 (20.8%)
General	123 (16.6%)
Cardiac	82 (11.1%)
Others	144 (19.4%)
LMA size	
1.0	17 (2.3%)
1.5	136 (18.4%)
2.0	475 (64.1%)
2.5	113 (15.2%)

ASA = American Society of Anesthesiologists classification

Table 3. Correlation between size of LMA and body weight (BW) in Thai children

LMA size (n)	BW (kg), mean ± SD (range)	Ghai et al.[3] BW (kg), range	Recommended BW from the present study (kg), range
1.0 (16)	5.06±1.61 (2-8)	<5	<7
1.5 (135)	8.75±1.96 (4-15)	5-10	7-11
2.0 (473)	14.08±2.80 (8-22)	10-20	11-17
2.5 (113)	21.64±6.26 (10-48)	20-30	15-28
Total (737)	14.07±5.24 (2-48)		

Correlation coefficient = 0.746 (p<0.001)

Table 4. Correlation between LMA size and age in Thai children

LMA size (n)	Age (months), mean ± SD (range)	Brimacombe et al.[4]	Age range recommendation from the present study (months)
1 (16)	2.62±2.13 (0-7)	<6	<6
1.5 (136)	14.28±11.76 (2-72)	6-12	6-24
2 (475)	36.19±18.56 (7-96)	12-60	24-60
2.5 (113)	59.04±22.63 (12-96)	60-120	60-84
Total (740)	34.93±22.69 (0-96)		

Correlation coefficient = 0.606 (p<0.001)

Discussion

The present study demonstrated a statistically significant correlation between LMA size, body weight, and age (p<0.001). However, the correlation coefficient was higher for body weight than age (0.746 and 0.606, respectively). Our findings suggested that body weight is a reliable predictor for appropriate LMA size in Thai pediatric patients.

According to manufacturer guidelines, LMA size 1 should be used in patients whose weight is less than 5 kg (e.g., neonatal resuscitation). However, there is no data supporting the clinical efficacy of this recommendation[2]. From the results presented in Table 3, LMA size 1 is recommended as appropriate in children weighing up to 7 kg, which differs from the manufacturer's recommendations.

Proper LMA size selection provides better patient safety in all age groups[8]. Brimacombe et al[4] proposed different LMA sizes for adult male and female patients, but no recommendations for pediatric patients[9]. In our study, gender was not a relevant factor for LMA size selection in pediatric patients.

In pediatric patients, small LMA appears to fail more often than large-size LMA[3]. However, some authors have questioned the clinical significance of proper LMA size, suggesting that even poorly positioned, LMA can create successful ventilation without adverse effect on gas exchange[10].

Interestingly, predictors for appropriate LMA size are different from those used for endotracheal tube. Chumpathong et al[11] investigated 2 to 7-years-old cardiac surgical patients and found that both age- and height-based formulas for estimating tube size delivered acceptable results with both parameters being equivalent and independent of physical development.

Conclusion

Body weight is a reliable predictor of proper LMA size selection in Thai children. In rare cases where body weight is not known, age can also be used as an acceptable alternative. LMA manufacturer weight recommendations for LMA size selection can be applied in Thai pediatric population aged eight years or less.

Limitations

This is a retrospective analysis and several crucial data might be missing. We were not able to obtain records of intraoperative events associated with LMA insertion, e.g. variable LMA insertion technique, LMA size switching, number of insertion attempts, cuff filling volume, pressure leak test[5], and failure rate. In addition, different LMA insertion techniques (e.g., rotational, lateral, and standard techniques) may affect insertion success rate[3]. Reasons for reinsertion or size-changing were not always recorded, an information deficiency which may affect the accuracy and significance of our results.

Cuff filling pressure has an influence on the LMA insertion process. Cuff filling procedure

involves proceeding with air titration until minimal or no leakage ventilation is achieved. Total cuff filling volume should not exceed the manufacturer's recommendation, which is less than 60 cm H_2O. To reduce perioperative airway morbidity, cuff filling pressures should be carefully monitored[12].

Proper LMA size selection was based solely on clinical parameters and was not confirmed by a more accurate approach such as fiberoptic laryngoscopy, which is generally accepted as the gold standard for this kind of evaluation[13].

Future studies should be undertaken to identify additional variables that would help predict successful LMA insertion (e.g., cuff volume and pressure, oropharyngeal leak test, and patient airway anatomy).

What is already known on this topic?

LMA size selection for adults and children should be based on patient weight.

What this study adds?

This study suggested the new recommendation of weight range for proper LMA size selection in pediatric patients.

Potential conflicts of interest

None.

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ขนาดของ laryngeal mask airway ในเด็กไทยควรเลือกใช้จากเกณฑ์อายุหรือน้ำหนัก

ฐิติมา ชินะโชติ, ศิริรัตน์ รัตนอาภา, เมธาวิน ปันธิโก

ภูมิหลัง: *ในปัจจุบันมีการถกเถียงกันว่าการเลือกขนาดของ layrngeal mask airway (LMA) ในผู้ป่วยเด็กควรทำนายจากอายุหรือ น้ำหนักของผู้ป่วย*

วัตถุประสงค์: *ทำการศึกษาว่าน้ำหนัก และ/หรือ อายุของผู้ป่วยเหมาะสำหรับใช้เป็นปัจจัยในการเลือกขนาด LMA สำหรับเด็กไทย*

วัสดุและวิธีการ: *ทำการศึกษาโดยวิธี retrospective review จากวันที่ 1 ตุลาคม พ.ศ. 2555 ถึง วันที่ 31 ธันวาคม พ.ศ. 2556 ในประชากรเด็ก 741 คน ที่มีอายุน้อยกว่า 8 ปี และพิจารณาหาความสัมพันธ์ของอายุและน้ำหนักกับขนาดของ LMA โดยระบุขนาด LMA ที่เหมาะสมโดยประเมินความสำเร็จจากการใส่ LMA หลังจากผู้ป่วยหลับโดยการถูกนำสลบ*

ผลการศึกษา: *จากผลการศึกษา แนะนำให้ใช้ LMA เบอร์ 1 ในผู้ป่วยเด็กที่น้ำหนักน้อยกว่า 7 กิโลกรัม LMA เบอร์ 1.5 ในผู้ป่วยเด็กที่น้ำหนัก 7-15 กิโลกรัม LMA เบอร์ 2 ในผู้ป่วยเด็กที่น้ำหนัก 11-17 กิโลกรัม LMA เบอร์ 2.5 ในผู้ป่วยเด็กที่น้ำหนัก 15-28 กิโลกรัม และพบว่าอายุของเด็กมีความสัมพันธ์ระดับน้อยกว่าน้ำหนักตัวในการเลือกขนาดของ LMA*

สรุป: *การเลือกขนาดของ LMA ควรพิจารณาจากน้ำหนักของผู้ป่วยเป็นหลัก โดยการศึกษานี้นำเสนอเกณฑ์ช่วงของน้ำหนักที่จำเพาะสำหรับการเลือกขนาดของ LMA สำหรับใช้ในผู้ป่วยเด็กไทย*