

Comparison of trapezius squeeze test and jaw thrust as clinical indicators for laryngeal mask airway insertion in spontaneously breathing children

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Abstract

Background and Aims: It is not known whether trapezius squeeze test (TPZ) is a better clinical test than jaw thrust (JT) to assess laryngeal mask airway (LMA) insertion conditions in children under sevoflurane anesthesia.

Material and Methods: After the Institutional Ethics Committee approval and written informed parental consent, 124 American Society of Anesthesiologists I and II children of 2–8 years of age undergoing minor surgical procedures were randomized into TPZ and JT groups. The children were induced with 8% sevoflurane in oxygen at a fresh gas flow of 4 L/min. TPZ or JT was performed after 1 min of start of sevoflurane and then every 20 s till the test was negative, when end-tidal (ET) sevoflurane concentration was noted. Classic LMA of requisite size was inserted by a blinded anesthetist and conditions at the insertion of LMA, insertion time, and the number of attempts of LMA insertion were recorded.

Results: The mean LMA insertion time was significantly longer ($P < 0.001$) for TPZ (145 ± 28.7 sec) compared to JT group (111.8 ± 31.0 sec). ET sevoflurane concentration at the time of LMA insertion was comparable in the two groups. LMA insertion conditions were similar in the two groups. There was no difference between the two groups regarding total number of attempts of LMA insertion. Heart rate (HR) decreased in both groups after LMA insertion ($P < 0.001$) but TPZ group had significantly lower HR compared with the JT group up to 5 min after LMA insertion ($P = 0.03$).

Conclusion: Both JT and TPZ are equivalent clinical indicators in predicting the optimal conditions of LMA insertion in spontaneously breathing children; however, it takes a longer time to achieve a negative TPZ squeeze test.

Key words: Children, jaw thrust, laryngeal mask airway, trapezius squeeze test

Introduction

Laryngeal mask airway (LMA) is a commonly used supraglottic airway device for conduct of anesthesia in children. Adequate depth of anesthesia is essential during insertion of LMA to obtund the hemodynamic responses and airway reflexes. Lighter plane of anesthesia during LMA insertion can lead to airway complications^[1] while a deeper plane can

result in hypotension and bradycardia.^[2] The clinical markers commonly used to assess the adequacy of anesthesia for LMA insertion in both adults and children include measured dose of intravenous anesthetic,^[2] loss of verbal response (LOV),^[3] loss of eyelash reflex (LOE), jaw relaxation,^[4] end-tidal (ET) concentration of volatile anesthetics,^[5,6] weighed syringe drop technique,^[7] and jaw thrust (JT) maneuver.^[8,9] LOV and LOE are associated with lighter planes of anesthesia and are not suitable indicators.^[4,10] ET anesthetic concentration depends on age, gender, body weight, dose, and cardiac

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output, and its use is impractical because of a long equilibration time of 10–15 min.^[1] TPZ and JT have been found to reliably assess adequate anesthetic depth for LMA insertion in adults as well as children.^[1,8,11,12] In adults, TPZ was a superior indicator of adequate conditions for LMA insertion than JT under sevoflurane anesthesia,^[12] whereas JT was a good clinical indicator under propofol anesthesia.^[11] As sevoflurane is the most common inhalational agent used for induction of anesthesia in children, and TPZ and JT have not been compared in children under sevoflurane anesthesia, we planned to assess the LMA insertion characteristics following TPZ and JT maneuver in children anesthetized with sevoflurane.

Material and Methods

The present study was a randomized prospective comparative study, conducted between June 2012 and December 2013. After the Institutional Ethics Committee approval (NK/375/MD/9753-54) and written informed parental consent, 124 children of age 2–8 years and the American Society of Anesthesiologists (ASA) Physical Status I or II undergoing minor surgical procedures such as orthopedic or urologic surgery were enrolled in the study. The trial was not registered in the Central Trial Registry of India. Children with predicted difficult intubation and ventilation, acute respiratory tract infection, and previous history of or family history of malignant hyperthermia were excluded from the study. Children were randomized into group TPZ ($n = 62$) and group JT ($n = 62$) by computer-generated random number table which was kept in sequentially numbered opaque envelopes.

All children were premedicated with oral midazolam 0.5 mg/kg about 30 min before the start of surgery. Parental separation of the child at the time of transfer to the operation theater was assessed using a 3-point sedation scale (1 = tearful/combativeness; 2 = alert/awake; 3 = drowsy/sleeping). The children were induced with 8% sevoflurane with oxygen at a fresh gas flow of 4 L/min. No neuromuscular blocking agent was used. Anesthesia was maintained with oxygen, nitrous oxide ($\text{FiO}_2 = 0.5$), and sevoflurane (minimum alveolar concentration [MAC] = 2). TPZ or JT was performed as per randomization after 1 min of the start of sevoflurane and then every 20 s till the test was negative. At that point ET sevoflurane concentration and MAC were noted.

The trapezius is a flat muscle that extends from the back of the neck to the shoulder girdle. In group TPZ, approximately 1"–2" of the trapezius muscle near the base of the neck was squeezed between thumb and index and middle fingers.^[13] In group JT, the JT was performed gently by lifting the angles of

the mandible vertically upward. If required, the thumb was used to retract the lower lip to keep the mouth open. JT was relaxed to a previously tolerated level if a motor response was elicited. In both groups, the child was observed for motor responses such as gross purposeful movements and movement of great toe.

A classic LMA of requisite size was inserted immediately after a negative response to TPZ or JT tests by an anesthesiologist who was not involved with the study and who was blinded as to how the end-point was achieved. An anesthetist with >3 years of experience inserted the LMA. The conditions at insertion of LMA were scored by a variable scoring system (score of 18 = excellent, 16–17 = satisfactory, <15 = poor).^[13] Effective ventilation was determined by observing chest wall movement, auscultation, and capnography. The insertion time was measured from sevoflurane administration to the negative TPZ or JT tests. Monitoring included electrocardiogram, noninvasive blood pressure, oxygen saturation, and ETCO_2 . The above parameters were recorded before induction, every minute till the insertion of LMA and then every 5 min till the end of the procedure. The number of attempts of LMA insertion was recorded.

Statistical analysis

In a previous study, JT had a success rate of detecting adequate depth of anesthesia for LMA insertion in 70% of patients.^[12] To detect a 90% success rate with TPZ with an alpha error of 0.05 and power of 0.8, the sample size was determined to be 62 patients.

Continuous variables were expressed as mean and standard deviation and compared using unpaired *t*-test. Various scores were expressed as median (interquartile range [IQR]) and compared using Mann–Whitney U-test. Categorical data were presented as percentage and compared using Chi-square test or Fisher's exact test. $P < 0.05$ was considered statistically significant.

Results

One hundred and twenty four children were recruited and randomized to TPZ ($n = 59$) and JT ($n = 65$) groups. Four children were excluded in the JT group: LMA insertion was not attempted because of a technical problem with sevoflurane vaporizer in two children, in one child, vomiting occurred during the induction of anesthesia, and LMA insertion was abandoned in favor of endotracheal intubation and in another child, LMA insertion was attempted thrice; however, the correct placement was not successful, following which endotracheal intubation was performed [Figure 1].

There were no significant demographic differences between the two groups with respect to age, gender, and weight.

The children between the two groups were comparable with respect to ASA classification and parental separation scoring [Table 1]. The mean LMA insertion time was significantly longer ($P < 0.001$) in TPZ group compared to JT group [Table 2]. ET sevoflurane concentration at the time of LMA insertion was not significantly different in the two groups. LMA was inserted in all 59 children (100%) of TPZ group and in 61 of 65 children (94%) of JT group. Insertion conditions were poor in five children (4%) belonging to JT group. None of the children in TPZ group had poor insertion conditions. However, there was no significant difference in LMA insertion conditions between the groups. LMA was successfully inserted in the first attempt in all the 59 children of TPZ group and 57 of 62 children in JT group. There was no significant difference between the two groups regarding total number of attempts of LMA insertion [Table 2].

There was no significant difference in the heart rate (HR) between the two groups just before insertion of LMA. HR decreased in both of the groups after LMA insertion ($P < 0.001$). Children in the TPZ group had significantly lower HRs when compared with the JT group up to 5 min after LMA insertion ($P = 0.03$, $P = 0.04$) [Figure 2]. There were no significant differences in blood pressure values between the groups before or after insertion of LMA [Figure 3].

Table 1: Demographic and clinical characteristics

Parameters	Trapezius squeeze group (n=59)	Jaw thrust group (n=65)	P
Age (years)	4.6±2	4.3±2.1	0.47
Weight (kg)	15.4±4.6	15.8±5.5	0.68
Gender (Male:female)	51:8	58:7	0.22
ASA 1/2/3	57/2/0	62/2/1	0.71
Parental separation score 1/2/3	11/31/17	12/30/23	0.67

Values are expressed as mean±standard deviation and analyzed using independent t-test or as numbers and analyzed using Chi-square test. ASA = American Society of Anesthesiologists

Table 2: Laryngeal mask airway insertion characteristics

Parameters	Trapezius squeeze group (n=59)	Jaw thrust group (n=62)	P
LMA insertion time (s)	145.4±28.7	111.8±31.0	<0.001
ET sevoflurane (%)	6.1 (5.9-6.6)	6 (5.9-6.5)	0.48
LMA insertion conditions excellent/satisfactory/poor	51/8/0	49/8/5	0.102
Number of attempts of LMA insertion 1/2/3*	59/0/0	57/4/1	0.086

Values are expressed as mean±standard deviation and analyzed using independent t-test; as median (interquartile range) and analyzed using Mann Whitney U test or as numbers and analyzed using Chi-square test. LMA = Laryngeal mask airway, ET = End-tidal

Discussion

We found that both TPZ and JT techniques are good methods for assessing the depth of anesthesia for LMA insertion

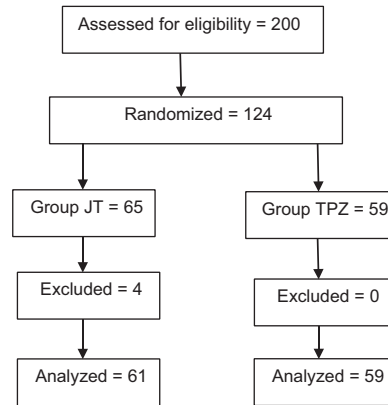


Figure 1: Consort flow chart of patients

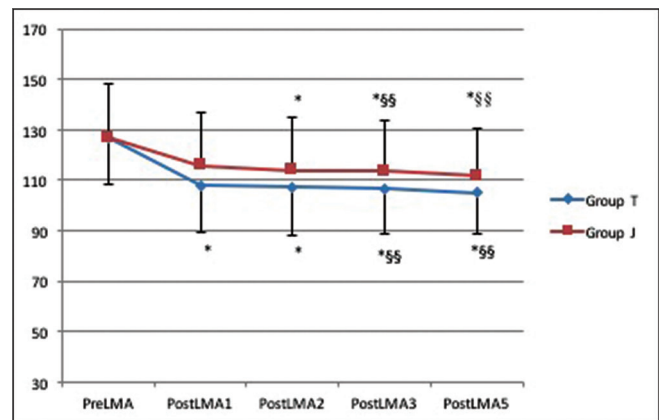


Figure 2: Heart rate before and after insertion of laryngeal mask airway. Trapezius squeeze group indicated by dashed line and Jaw thrust group by solid line. LMA = laryngeal mask airway. Within group comparison from the pre-LMA value: * $P < 0.001$ (ANOVA); Intergroup comparison: § $P = 0.03$, §§ $P = 0.04$ (independent t-test)

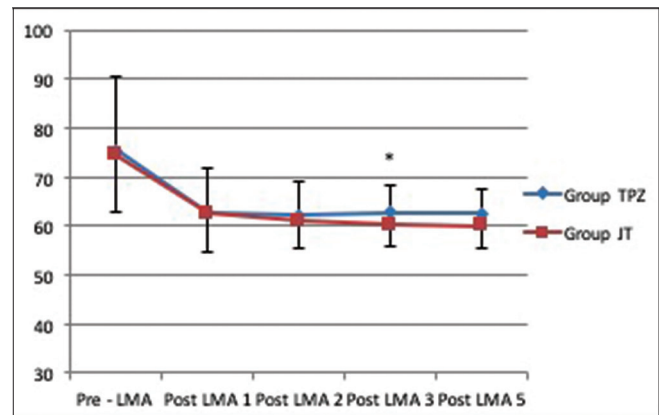


Figure 3: Mean blood pressure before and after insertion of laryngeal mask airway. Trapezius squeeze group indicated by dashed line and Jaw thrust group by solid line. LMA = laryngeal mask airway. Within group comparison from the pre-LMA value: * $P < 0.001$ (ANOVA)

in children under sevoflurane anesthesia. The insertion conditions, number of insertion attempts, and the success of LMA insertion were similar with both the methods. However, the time for LMA insertion was significantly longer in patients where TPZ was used for assessing the depth of anesthesia when compared to the JT. The ET sevoflurane concentration was comparable in both groups at the time of LMA insertion. Neither of the techniques was associated with any clinically significant hemodynamic change.

LMA insertion needs an optimal and adequate depth of anesthesia to prevent untoward hemodynamic and airway complications, especially in children who are more prone to these problems. Many subjective and objective predictors have been utilized to assess the adequate plane of anesthesia for inserting the LMA. However, a simple, cost-effective, reliable, repeatable, reproducible, and precise clinical predictor which is devoid of side effects is desirable.

In our study, LMA was successfully inserted in all 59 children of TPZ group (100%) and in 61 of 62 children of JT group (98%). Earlier prospective studies using TPZ during sevoflurane anesthesia in children have found a success rate of LMA insertion of 91%–96%.^[1,14] These studies, however, did not compare TPZ with JT technique for assessing the success of LMA insertion. These techniques have been compared in adults in a prospective randomized controlled study, where a higher success rate of 96% was found with TPZ compared to 72% with JT method.^[12]

We defined the LMA insertion time as the time from the start of sevoflurane till the time the tests became negative and found it to be significantly longer in TPZ group (145 ± 28.7 s) as compared to JT group (111.8 ± 31.0 s). This time in our study is much shorter than that reported in the other studies. Chang *et al.* using TPZ as an indicator of optimal conditions for LMA insertion in children showed the elapsed time to complete insertion of LMA of 342 ± 114 s.^[11] The same authors in adults observed that the time needed for LMA insertion in TPZ and JT groups was 246 s and 150 s, respectively.^[13] Hooda *et al.* using TPZ as an indicator of optimal conditions for LMA insertion in children showed that elapsed time to complete insertion of LMA was 271 s.^[14] This difference in the time needed to achieve a negative response to JT or trapezius squeeze may be related to the difference in the conduct of anesthesia. In the studies quoted above, anesthesia was induced with a semiclosed-circuit system, which was primed with 6% sevoflurane. In contrast, we used 8% sevoflurane with a Jackson Rees' modification of Ayre's T-Piece for induction. The higher sevoflurane concentration probably helped in achieving a faster depth of anesthesia in our study.

There was also a difference in the ET sevoflurane concentration achieved for the test to become negative between Chang's study and our study.^[11] In Chang's study, the ET sevoflurane concentration was significantly higher in the trapezius squeeze group ($4.1\% \pm 0.7\%$) than in the JT ($3.2\% \pm 0.9\%$) group. This suggested that the JT maneuver is not an adequate stimulus for assessing the anesthetic depth for LMA insertion in adults. However, these results from the adult population cannot be extrapolated to the pediatric population. In our study, the ET sevoflurane concentration was higher than that in the Chang's study but was similar in the trapezius (6.1%) and JT (6%) groups. Children when compared to adults require a higher MAC because they have high alveolar ventilation and a small functional residual capacity; the combination of which enhances the rise of alveolar concentration and a rapid delivery of inhalational anesthetics to the brain. Furthermore, MAC values of sevoflurane are very high in infants. A study by the same author in pediatric population using TPZ as the clinical indicator for optimal LMA insertion conditions had an ET sevoflurane concentration of 3.6 ± 1.1 vol%.^[11] In this study, the children were premedicated with thiopental sodium 3 mg/kg for parental separation which may have contributed to the lower ET concentration of sevoflurane for LMA insertion. In our study, in JT group, five children had poor LMA insertion conditions compared to none in the TPZ group. This probably indicates that the intensity of noxious stimulus produced by trapezius squeeze is more than JT; therefore, it took a longer time to make the test negative.

HR, as well as blood pressure (systolic blood pressure, diastolic blood pressure, mean blood pressure), decreased in both of the groups after LMA insertion although the fall was <20% from the baseline. The absence of an increase in these hemodynamic parameters after insertion of LMA indicates that the tests were successful in assessing the adequacy of anesthetic depth. Children in the TPZ group had significantly lower HRs as compared to the children in the JT group which lasted up to 5 min after LMA insertion. This could be due to longer insertion time in TPZ group (145 s) than in JT group (111 s) leading to longer duration of sevoflurane exposure in the children in TPZ group.

A limitation of this study is that these findings cannot be applied to children of ages other than 2–8 years, especially infants, in whom the MAC is different. Furthermore, our findings are limited to the anesthetic technique used by us, i.e., premedication with midazolam followed by induction with 8% sevoflurane and maintenance with nitrous oxide and sevoflurane and cannot be extrapolated to different anesthetic techniques.

Conclusion

In adults, the success rate with JT is low, about 70%, and it increases to about 90% with TPZ. Our study shows that JT and trapezius squeeze are equivalent clinical indicators in predicting the optimal conditions for insertion of LMA in spontaneously breathing children under sevoflurane anesthesia. However, the time taken to achieve a negative TPZ is longer.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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CONFERENCE CALENDAR January-March 2017

Name of conference	Dates	Venue	Name of organising Secretary with contact details
10 th National Conference of Association of Obstetric Anaesthesiologists .AOACON 2017.	September 30 th - October 2 nd 2017	Hotel Clarks Exotica, Bengaluru, India	Dr. Murali Chakravarthy Organizing Chairman Dr. Anitha Prashanth Organizing Secretary E-mail: aoa2017blr@gmail.com Website: www.aoabengaluru.in
65 th Annual national Conference of the Indian Society of Anaesthesiologists	November 25 th -29 th , 2017	Biswa Bangla Convention Center, Newtown, Rajarhat, Kolkatta, India	Dr. Sumanta Dasgupta Organizing Chairman Dr. Subhendu Sarkar Organising Secretary Mobile:9831171162 Indian Society of Anaesthesiologists (West Bengal State Branch) 41 D,Palm Avenue, Kolkata-700019 Website: http://isacon2017kolkata.com