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COMPARATIVE EVALUATION OF THREE DIFFERENT TECHNIQUES OF CLMA™ INSERTION (MIDLINE, LATERAL AND ROTATIONAL) IN PAEDIATRIC PATIENTS

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ABSTRACT Classic laryngeal mask airway™ (cLMA) is frequently used in management of paediatric airway. We compared the success and ease of insertion of three techniques of cLMA insertion; the midline, lateral and rotational technique with cuff partially inflated in 120 children. Patients were randomly allocated into one of the three groups i.e. Group I (midline), Group II (lateral) and Group III (rotational). First attempt success rate in group II (100%) and III (97.5%) were significantly better as compared to group I (87.5%), p=0.025. Time for successful insertion was significantly lower in groups II and III compared with group I ($p < 0.05$). Group II and III demonstrated improved fibreoptic view as compared to Group I. This study demonstrated that lateral and rotational techniques of partially inflated cLMA insertion in paediatric age group are better than midline technique with respect to ease of insertion, first attempt and overall success rate.

KEYWORDS : classic laryngeal mask airway, paediatric, insertion techniques, rotational, lateral, midline

INTRODUCTION

The classic laryngeal mask airway (cLMA) is a novel supraglottic airway device frequently used for airway management in paediatric anaesthesia. Paediatric cLMA is the diminutive version of the adult LMA despite differences in adult and paediatric anatomy. Frequent presence of tonsillar hypertrophy, a relatively large tongue, a higher and more anterior larynx with a relatively large floppy epiglottis may be responsible for hindrance in correct placement of cLMA in paediatric population. Consequently the technique recommended by Brain, the standard technique (midline) with cuff fully deflated is not always easy and has demonstrated a varying range (67-90%) of successful insertion at first attempt in children.[1-5] Various methods have been designed to improve success rates including use of partially inflated cuff, changing the direction of insertion in the form of lateral and rotational techniques.[6-8]

Several techniques of LMA insertion have been suggested in adults but only a few clinical trials have been conducted in children. The purpose of this prospective, randomized study was to compare midline, lateral and rotational techniques with cuff partially inflated with respect to ease of insertion, success rate, positioning of LMA as assessed through a fibreoptic bronchoscope and adverse events if any in children.

MATERIAL AND METHODS

This prospective, randomized study was approved by the Institutional Review Board of our hospital and was registered in Clinical trials registry-India (CTRI/2017/11/010365). The study was implemented after obtaining consent from the parents of participating patients. The study included 120 ASA I & II patients of either sex, between 1-6 years of age, scheduled for various elective surgical procedures. Patients with upper respiratory tract infection, restricted mouth opening, congenital heart disease, risk of aspiration and position other than supine were excluded from the study. All the patients were randomly allocated to Group I (midline technique), Group II (lateral technique) and Group III (rotational technique) of 40 patients each using sealed envelopes.

After ensuring adequate fasting all the patients were premedicated with 0.5mg kg^{-1} midazolam syrup orally 1 hr prior to induction of anaesthesia. Routine monitoring comprising of electrocardiography, pulse oximetry and non invasive blood pressure and end tidal carbon dioxide was initiated. Induction of anaesthesia was achieved with inhalation of 5–7% sevoflurane in 100% oxygen. Intravenous line was then secured followed by Inj. Fentanyl 2mcg/kg, Inj. Atracurium 0.5mg kg^{-1} and after ventilating the patient for 2 minutes, an appropriate size cLMA was inserted using the midline, lateral and rotational techniques in group I, II and III respectively. The cLMA was inserted by a single operator who had practiced minimum of 10 insertions with each technique. The size of the cLMA and maximum inflation volume selected was according to the patient's weight as per manufacturer's recommendation.[11]

In **group I**, the cLMA was inserted using the midline technique. Well lubricated partially inflated cLMA was held like a pen and inserted while pressing against the palate and posterior pharyngeal wall using the index finger until resistance was felt when the mask tip reached the triangular base of the oropharynx.

In **group II**, cLMA was inserted using the lateral technique. Well lubricated partially inflated cLMA was inserted using the same grip as above, until the entire cuff is inside the mouth, thereafter; it was rotated laterally by 45° to occupy the position by the side of the tongue with the aperture facing the tongue. With the tube between index finger and the thumb, the cLMA was advanced as far as possible until resistance was felt and then rotated back to the midline and insertion was accomplished.

In **group III,** cLMA was inserted using the rotational technique. Well lubricated cLMA was inserted with its lumen facing backwards and then rotated through 180° when the resistance of the posterior pharyngeal wall was felt and then passed downwards into the position behind the larynx.

After insertion, the cuff was inflated as per manufacturer's recommendation and the airway device was connected to the anaesthesia breathing system. Correct placement of the cLMA was confirmed by auscultation of breath sounds, by observing conduction of chest excursion to the bag along with a square wave capnography. After insertion of bite block, cLMA was secured. The primary outcome measure was success rate at the first attempt using three different insertion techniques. We also assessed overall success rate, ease of insertion, time before successful LMA insertion, optimal positioning, haemodynamic changes and complications. Ease of insertion was graded on a three point scale (easy, difficult, failure). An easy insertion was defined as insertion in a single manoeuvre. A difficult insertion was one where more than one attempt was required to seat the device. In case it was not possible to insert the LMA with a single technique in two attempts it was labelled as failure. In case of failure, the standard Brain technique for cLMA insertion was used to secure the airway using single attempt. Patient was intubated with proper size endotracheal tube if we were unable to secure the airway with cLMA with a total of 3 attempts. The time interval between mouth opening and obtaining an effective airway was noted. Flexible fibreoptic scope was introduced into the airway tube just next to the mask aperture bars to score the laryngeal view by another operator blind to the technique used. The airway view was scored using an established scoring system (Grade I- larynx only seen. Grade II- epiglottis and larynx seen, Grade III- epiglottis impinging on grille, larynx seen, Grade IV- kinked laryngeal mask airway, Grade V- epiglottis down folded, larynx not seen).[12] Haemodynamic parameters were also noted at frequent intervals.

Post-operative blood staining of cLMA, hypoxic episodes (SpO_2 below 92%), airway obstruction, coughing, gagging, laryngospasm, gastric insufflation was recorded after removal of device.

Sample size calculation was performed based on the assumption that the rotational or lateral technique would improve the success rate at the first attempt to 97% from 70%. With alpha error of 0.05 and power of 90%, 38 patients in each group were required. The data was compiled and analyzed statistically by using mean, standard deviation, ANOVA, chi square test and paired't' test. The results were considered significant when the p value was <0.05.

RESULTS

Demographic variables including age, sex, weight and ASA status were comparable in the three groups (Table I). The characters of device insertion are shown in Table II. Different sizes of cLMA used were also comparable, with size 2 being the most common.

The first attempt success rate for cLMA insertion using midline technique was 87.5% (35/40) which was significantly lower as compared to lateral technique 100% (40/40) and rotational technique 97.5% (39/40) (p<0.05). In three patients of the midline group (7.5%), LMA could not be placed after 3 attempts and were labelled as failures. Endotracheal intubation was used as an alternative method of securing the airway. These patients were thus excluded from analysis of insertion time and fiberoptic grading. No failures were observed in lateral and rotational groups. Insertion was significantly faster using either lateral (10.65±0.72 secs) or rotational (10.89±2.97 secs) technique as compared to midline (13.58±3.9 secs) technique (p< 0.05). cLMA insertion was difficult while using midline technique in two patients and in one patient while using rotational technique. Fibreoptic grading of airway tube revealed Grade 1 (larynx only) in 7/37(18.9%), 20/40(50%) and 23/40(57.5%) cases in groups I, II and III respectively. Larynx was directly seen (i.e. grade 1+2) in 100% of patients in lateral and rotational groups which was significantly better than 86.4% in case of midline group patients which was statistically significant (p<0.05). There was no significant difference noted in haemodynamic response (heart rate, systolic and diastolic blood pressure) at various time intervals when all the three techniques were compared. Blood was present on LMA at removal as evidence of injury in 3, 2 and 1 cases in midline, lateral and rotational group respectively. There was no significant difference (p>0.05) in between all the three groups with regard to morbidity. No episode of desaturation or laryngospasm was noted in any case in our study.

DISCUSSION

Paediatric LMA is the scaled down version of adult LMA despite differences in the airway anatomy. Insertion of fully deflated LMA using the standard midline technique as described by Brain has variable success rate at first attempt (65-90%).[1-5] Several alternative methods have been designed to make the change in direction of the mask and to reduce the tendency to impaction in the pharynx compared with the standard method. For example, insertion of the mask with the cuff partially inflated is said to minimise the likelihood of the cuff folding back and help in negotiating the posterior curve of pharynx. [6-9] Alternatively, inserting the mask back-to-front like a guedel airway and then rotated 180^0 as it was pushed into hypopharynx (rotational technique) has been reported as an effective manoeuvre.[10] Another technique would be to utilize a partially inflated cuff by the lateral approach that is relatively free of mechanical hindrance and allows a free passage as used for insertion of the laryngoscope blade.[7,8] In their paediatric series, O'Neill et al reported that success rate at the first attempt increased from 85.5% to 96.7% using a 'partially inflated cuff' technique.[9] Our study demonstrated the first attempt success rate of 87.5% with this 'midline technique' with cuff partially inflated. As compared to midline technique, first attempt success improved to 100% using lateral technique and 97.5% using rotational technique. The overall success rate (i.e. successful insertion within two attempts) of 92.5% for LMA insertion using midline technique was found to be significantly lower as compared to 100% using lateral and rotational technique (p<0.05). Ghai et al also achieved similar first attempt success rate of 96% with rotational technique as compared to 80% with standard technique.[1] But first attempt success rate using lateral technique by them was found to be low (84%) as compared to ours of 100% which may be attributed to lower cuff inflation volumes used by them. High first attempt success rate of 97.5% with rotational technique was in accordance with previous studies done by Nakayama et al (99%)and Soh et al (100%).[5,13] Kundra et al also reported success rate of 97.5% using lateral technique which was in accordance to ours of 100%.[7] In three patients of the midline group (7.5%), 3 attempts were required for LMA insertion (2 using the midline technique with cuff partially inflated and 1 with standard Brain technique). However LMA could not be placed after 3 attempts and they were thus labelled as failures. Endotracheal intubation was used as an alternative method of securing the airway.

In this study, insertion was significantly faster using either lateral (10.65±0.72 secs) or rotational technique (10.89±2.97secs) as compared to midline technique (13.58±3.9 secs) (p< 0.05). Insertion time was comparable between lateral and rotational groups (10.65 vs.10.89 seconds, p>0.05). Ghai et al reported significantly faster insertion time using rotational technique 11.43± 3.20 seconds as compared to standard (14.37±4.10 secs) and lateral technique (14.2±4.02 secs) (p<0.001) which was similar to our study except longer time taken with lateral technique which may probably be explained on the basis of lesser amount volume used by them in LMA cuff before insertion.[1] Kundra et al reported significantly faster insertion using partially inflated lateral technique (14.4±4.2 seconds) as compared to midline deflated technique (23.1±2.1 seconds, p<0.05) which is in accordance with our study.[7]

We were able to obtain Grade 1 (larynx only) view using fiberscope in 50% and 57.5% cases and Grade 2 (both epiglottis and larynx) in 50% and 42.5% cases using lateral and rotational technique respectively, which was significantly better than midline group (18.9% and 68.6%). Grade 3 (epiglottis impinging on grille but larynx) was seen in 13.5% cases in group using midline technique while none was seen in lateral and rotational group. Larynx was directly seen (i.e. grade 1+2) in 100% of patients in lateral and rotational groups which was far better than 86.4% in case of midline group patients which is statistically significant (p<0.05). Kundra et al reported that grade I fibreoptic view was noted in only 39% of patients in midline deflated group, as compared to 52% in partially inflated lateral group.[7] The authors were able to visualize the larynx directly in 100% of patients using partially inflated lateral technique as compared to 87% in midline deflated group (p<0.05) which is comparable to our study (100% and 86.4% in lateral and midline group respectively, p<0.05). There was no significant difference noted in hemodynamic response at various time intervals when all the three techniques were compared.

Blood was present on LMA at removal as evidence of injury in 3, 2 and 1 cases in midline, lateral and rotational group respectively. No episode of desaturation or laryngospasm was noted in any case in our study. Ghai et al and Kundra et al reported similar incidence of blood on LMA at removal.[1,7]

From the various factors studied in this study we conclude that both lateral and rotational techniques of LMA insertion in paediatric age group are better than midline technique with respect to ease of insertion, first attempt and overall success rate. Also, lateral and rotational techniques are significantly faster when compared to midline technique. However, both lateral and rotational techniques have similar first attempt and overall success rates. There is also not much difference in time taken to insert LMA when both of these techniques were compared. So from above observations noted in our study we conclude that both lateral and rotational techniques can be used as preferred techniques over midline technique for LMA insertion in paediatric age group.

Table I- Demographic variables

	Group I	GroupII	GroupIII	*P value*
Age (yr)	3.5+1.8	3.8+1.6	3.7+1.8	0.71
Sex(M:F)(n)	38 : 2	37 : 3	37 : 3	0.87
Weight (kg)	13.7+3.6	15.0+3.9	14.0+3.7	0.31
ASA I	40	40	40	NS

Values are expressed as mean+SD or number of patients.

Table II- Device characteristics

	Group I	GroupII	GroupIII	*P value*
Size of device used (1.5/2/2.5)	6/29/5	6/25/9	7/30/3	0.738
Attempts of insertion (1/2/3)(n)	35/2/3	40/0/0	39/1/0	0.024
Ease of insertion(E/D/F)*	35/2/3	40/0/0	39/1/0	0.024
Insertion time (secs)	13.6+3.9	10.6+0.72	10.8+2.9	0.00
Fiberoptic grading (1/2/3) (n)	7/25/5	20/20/0	23/17/0	0.00
Blood on device after removal(n)	3	2	1	0.53

Values are expressed as mean+SD or number of patients,*-easy/difficult/faliure

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